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ANNUAL REPORT

OF THE

Massachusetts.

HARBOR AND LAND COMMISSIONERS

FOR THE YEAR 1880.

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Commonwealth of Massachusetts.

HARBOR AND LAND COMMISSIONERS' REPORT.

To the Honorable the Senate and the House of Representatives of the Commonwealth of Massachusetts.

THE Board of Harbor and Land Commissioners, in accordance with the provisions of law, respectfully submit their annual report for the year 1880.

SOUTH BOSTON FLATS.

The total cost of this land to Dec. 31, 1880, has been, \$1,148,847 69

The receipts have been, —

From Boston and Albany Railroad, for land, \$330,000 00

From New York and New England Railroad,

for land 1,108,165 00

From New York and New England Railroad,

for rent 10,500 00

From Boston Wharf Company, for land . 1,354 20

————— 1,450,019 20

Showing, exclusive of interest, a profit to the Commonwealth, to Dec. 31, 1880, of

\$301,171 51

From this statement it appears that the aggregate amount of sales, and the amount received for rents, &c., of the South Boston lands, already exceeds by the sum of \$301,171.51 the whole amount expended by the State at South Boston. And there is still a large sum due from the Boston and Albany Railroad, for its purchase of fifty acres, besides damages for non-fulfilment of contract.

The sales above reported cover all the filled land at South Boston, and leave belonging to the Commonwealth some seven hundred acres of flats, upon a very small portion of which has money been expended for reclamation; and, with active work, it will take two years to prepare for use a single dock and the adjoining piers.

On the 28th of August last, a contract, of which a copy will be found in the Appendix, was made with Thomas Potter for dredging three hundred thousand yards of material from the flats beyond the line of the proposed outer wall, and placing the same upon the flats proposed to be filled, the whole work to be completed by the 1st of January, 1883. This contract has been duly approved by the Governor and Council. It exhausts the appropriations already made; and a further appropriation will be necessary in order to complete retaining-walls, and walls for the required dock, so that the work upon the walls may be prosecuted simultaneously with the filling. By the Act of 1878, Chap. 237, the fund called the Commonwealth's Flats Improvement Fund is established; and by the same act it is provided that proceeds of land at South Boston, when sold, shall be placed in this fund. From this fund an appropriation was made by the same act; and it is now asked that a further appropriation may be made from the said fund, sufficient for the purposes named, so that without further delay the necessary additional contracts may be made.

After the sale of the filled land was made, it was deemed advisable that the commission should obtain such knowledge of the construction, arrangement, and management of docks in Europe, as would enable it to make that use of the South Boston Flats which would conduce most to the advantage of trade, and meet its requirements, at the same time having due regard to the interests of the State. His Excellency concurred in this view; and one of the commission has visited Europe for these purposes, and has submitted to the Board a report of his examinations as follows:—

To the Board of Harbor and Land Commissioners.

GENTLEMEN, — Deputed by the Board, with the approval of his Excellency, to visit Europe for the inspection of docks and their connections with railroads, and especially to examine their systems of organization and management, I have the honor of submitting my report.

The first thing which attracted my attention, as I inquired about docks in Europe, was the great amount of work on docks which was in progress, contemplated, or just completed, in almost every port, whether great or small, throughout Great Britain, France, Belgium, Holland, and Germany. This work is to be attributed to two causes, —

1. The necessity of docks suited to the change of vessels from sail to steam; the latter requiring greater length of quayage, with wide sheds and broad landings, and a greater depth of water.

2. The necessity of preparing all ports which exported their special products to the ports of America, for the reception of the steamers which bring American produce or merchandise, because, with vessels such as are fitted for the Atlantic trade, it is impossible for them to discharge at one port and load at another. The models of the ships which do not permit their moving about, as sailing ships did, with swept holds or lightly ballasted, the long detention and double port charges, prevent and make it too costly. Therefore, for such ports it is necessary, in order to secure cheap and reasonable freights upon their exported products, to be able to accommodate with proper docks and railroad connections, all ships which may bring imported goods to the port. And so by being able to receive inward cargoes, ships are secured at the port for outward cargoes. In other words, such a port with good docks and railroad connections may establish a line of steamers to America which will be sure of cargoes both ways.

That the trade with America is of great importance, is shown by the fact that while the receipts of the Mersey Dock and Harbor Board for dock rates and tonnage rates during the year ending July 1, 1880, were £740,000 sterling, £360,000 sterling were collected from the United States trade, and £60,000 sterling more from the trade with the British North American provinces; or, nearly 57 per cent of these receipts were from the trade with North America.

In Great Britain one finds docks fitted for this trade, either just completed or in progress, in the ports of London, Liverpool, Hull, Newcastle, Hartlepool, Leith, Glasgow, Barrow, Fleetwood, Belfast, Bristol, Swansea, Cardiff, Newport, Plymouth, Southampton, and perhaps other places. In France, at Dunkirk, Havre, Bordeaux, and Marseilles. In Belgium, at Antwerp. In Holland, at Amsterdam and Rotterdam. In Germany, at Bremerhaven and Hamburg. The amount expended and to be expended is many millions in sterling.

In Amsterdam a canal fifteen miles long has been cut through to the North Sea, so that the port is no longer entered round the Texel and through the shallow Zuyder Zee, but is now a deep-water harbor, and twenty-four hours nearer the Atlantic trade than before. The canal is said to have cost five million dollars, and the docks being constructed will cost as much more. In Rotterdam docks, where the steamers in the American trade discharge and receive their cargoes, twenty-one millions of guilders, or over eight millions of dollars, have been expended. In Antwerp, a city which has lain almost dormant for three centuries, the docks built by Napoleon have been enlarged, deepened, and re-modelled, new docks are being built, and the whole water-front of the city changed to

insure deep water and regularity in the tidal flow, at a cost of many millions of dollars; and the city with its lines of steamers, and immense number of sailing vessels in the American trade, has become to-day the third or fourth commercial city of Europe. In Hamburg and Bremen large sums have been expended, and lines of steamers to America established. These five ports are to-day in competition for the great trade between America and Germany.

The four ports of France put the various portions of that great nation into direct communication with America; and their docks, their conveniences, and their cost are on the same scale as the docks in Germany, Holland, and Belgium. Indeed, it is a point very difficult to decide, as to which has the best, or which has expended the most. But all look to the American trade for their greatest revenue.

The ports of Great Britain are familiar to you by name. London and Liverpool are general ports, while most of the others are special ports. In most of the special ports there must have been expended a million of pounds sterling, and in some of them more. In the River Clyde, which fifty years ago was not navigable to Glasgow by ships of one hundred tons, there is now twenty-five feet of water, and there are ample docks, two or three lines of steamers to America, and the great ship-yards where are built a large proportion of the steamers now engaged in the American trade. The cost of making such a port, as Glasgow now is, has been many millions.

And so the various other ports might be described; but the plans of their docks, which you now have, will afford you ample information in regard to their plans and construction.

In London the great Victoria and Albert Dock, two miles long, has cut off a bend in the river, which it enters at either end; and here may be found the great steamers running to Boston and New York. So far as possible, every improvement has been introduced, and both here and at the East and West India Docks, every attempt has been made to facilitate business and to lessen charges in the handling of goods.

When I landed at Liverpool, the engineer of the Mersey Docks, Mr. Lyster, told me that in the handling of goods America had little to learn in Europe, and that he had sent his assistant to America, last year, to examine our system of handling goods in order that he might introduce in his new docks and warehouses now building in Liverpool all American improvements. Still he said there was one thing in which Europe was in advance of America, and that was the use of hydraulic machinery. This I found to be true, and no dock visited was found without large hydraulic engines and hydraulic cranes. But it was laughable at times to see how goods were handled so carefully, so easily, and so cheaply, by this splendid machinery, and then to see the whole saving wasted. For instance, at Antwerp a vessel with broken pig-iron was being discharged by one of the beautiful hydraulic swinging cranes of Sir William Armstrong. The iron was hoisted from the hold in a large tub, which, instead of being swung over to the car standing upon the track only fifteen feet away, and then dumped, was lowered to the deck, and then the iron was handled piece by piece, and placed in a basket, the basket placed upon a

man's shoulder, and the man walked down a plank to the dock, up another plank on the further side of the car, and then dumped his basket into the car. It was in vain to ask why the tub was not swung and then dumped, — they never did it so.

In London, with a hydraulic crane lying idle alongside the ship, bale goods were rolled from the car down to the pier, and then rolled up again to the vessel's deck. To the question "Why do you do so?" the answer was, "We always have."

In Liverpool, where grain is raised by hydraulic power to the highest story of the magnificent grain warehouse, and carried by a horizontal belt, moved by hydraulic machinery, at the rate of fourteen feet in a second, eighty tons of it in an hour, — with a railroad station two hundred feet away, the grain is lowered to the lowest floor, shovelled into a sack, the sack carried to a truck, and by the truck carried to an open car, upon which it is loaded, covered with a tarpaulin, and transported to the country. Mr. Lyster has tried in vain to extend his belt to the station. The railroad company says No, and grain is handled as it has always been. Thus, while science shows the way, and engineers desire to use the improvements which they have constructed, prejudice and custom say No, and absorb the saving of improved machinery. But in other places where they deal with their own products, prejudice and custom do not always interfere with science. In Newport there is a dock two thousand five hundred feet long, one side of which is devoted to coal shipments. Here science has had full sway. Parallel to the dock, and three or four hundred feet away from it, is the railroad track, elevated seven feet above the capsill. Upon this track the loaded cars come in, each car of four wheels holding eight tons of coal. At intervals of three or four hundred feet, there are switches from which curved tracks run to the capsill of the dock, on a descending grade. Upon these curved tracks the loaded cars are switched off. At the end of each track is a hydraulic lift, upon which the loaded cars are placed one at a time. One man handles the cars, and one man tends the lift. Every two minutes a car is raised fourteen feet, dumped by an opening at the end, tipped back on to a descending track which runs back on a curved line to the main track; and so, with only two men, coal is loaded into a single hatch of a vessel, at the rate of four tons to the minute, — an example of the rapidity and cheapness with which goods are handled when men will use the appliances which science furnishes.

This use of hydraulic machinery and gravitation was the most noticeable thing in connection with the handling of goods. Its simplicity and cheapness should attract attention, and wherever the two powers can be combined they should be used. But it is not merely for the handling of goods that hydraulic machinery is used in Europe. The docks there are mostly docks into which vessels can come only at high water, owing to the great rise and fall of the tide. At high water the gates are opened, and vessels pass in and out. Then the gates are closed, and high-water mark is retained inside the docks all the time, so that vessels lie constantly afloat, with their rails always at the same distance from the capsill of the dock. And it is to open and shut these great gates requir-

ing immense power, that hydraulic machinery is used. It is also used to pump out the graving docks which are found inside all first-class docks in Europe. The modern graving dock is over five hundred feet long, sixty feet wide, with twenty-five to thirty feet water over the sill. Such a dock as this is pumped dry in Liverpool by hydraulic machinery in less than an hour; and one of the largest steamers, the "Scythia," entered this dock, and went out in eleven hours, having been painted and cleaned in the interval, — the eleven hours being in the night, so that no time was lost. At the dock electric lights are used, so that men can work as well by night as by day.

The other noticeable thing in regard to docks is their common use by all on equal terms. There, railroad companies do not own and control docks, charging other railroads for their use, but in all cases the railroad tracks upon the docks and to the junction with railroads are owned by the dock company, which loads the cars and carries them to the junction, or receives them at the junction and unloads them, the charge to all railroads being the same. This is exemplified by the following advertisement of the Royal Victoria Docks at London: —

IMPORT GOODS. — There is no extra charge for delivery to railway trucks. The following railway companies have goods depots within the Victoria Docks, and the trucks run alongside the warehouses, viz.: Great Eastern, Great Northern, London and North-western, Midland, and, by special arrangement, the Great Western. Grain, flour, guano, provisions, and goods of every description, handed to above companies, as a rule arrive at destination the following morning, thus saving much time and risk; and no expenses for cartage or lighterage are incurred.

This list of railroads covers the principal companies in Great Britain. To each of these railroads cargo from any vessel in those docks can be delivered, and from each of these railroads any vessel in the docks can receive goods, at precisely the same cost per ton. In Liverpool it is the same. The three railroads there, the North-western, the Midland, and Great Western, have equal privileges. And so it is all over Europe. To whichever dock in whichever port a vessel goes, her cargo goes on equal terms to every railroad which has a track within the limits of the port, and from every railroad in the port cargo can be received on equal terms. In this country no such custom prevails. The great termini are owned by railroad corporations. Not to every railroad are allowed equal terms, but only to every railroad other than the owner. Thus vessels which in this country lie at a railroad terminus cannot receive cargo from, nor deliver cargo to, all railroads upon equal terms. The rate to all other railroads is different from the rate to the railroad at whose terminus the vessel lies. Freight to other railroads pays a terminal charge to the railroad owning the terminus, and a general cargo for different destinations must pay a charge or be sent over the road which owns the terminus. This may work well for the railroad, but it is against the public interest, and is injurious to the port. In Europe, if two railroads compete with each other, they bear the loss of the competition. Here, if they compete, the importer of goods does not get the whole benefit, because of the terminal charge to other railroads.

A merchant of Boston whose goods are at the Grand Junction Wharf cannot send his goods West by the Fitchburg or Lowell except by paying a terminal charge; nor can a vessel at either Constitution or the Lowell Wharf send goods West by any railroad except the railroad owning the terminus, unless he pays a terminal charge. This detracts from the advantage of Boston as a port. If the European system were adopted here, and ships lying in a foreign port could take freight for Boston to be sent thence by all railroads upon equal terms, the advantages of Boston would be more fully appreciated. Then steamers could come here assured that, at whatever dock they unloaded, they could at the same dock load from any railroad or from several railroads upon the same terms. Now a vessel coming to either wharf must load at the same wharf with such cargo as the railroad can furnish, or must haul to the wharf of another railroad to take the cargo which that road can furnish, or else the terminal charge comes in. Here it is, "Haul your vessel, or load with what we can give you by our cars." In Europe it is, "Stay where you are. Goods by all railroads will be brought to you on equal terms." Whether the system here can be changed, is worthy the consideration of both the legislature and the business men of Boston.

LIVERPOOL DOCKS.

But, while in so many ports in Europe there are docks which attract attention by their extent and convenience, it is in Liverpool that the most complete system of docks is to be found; and here is found also a form of management which secures uniformity of rates in the whole port, and to the business community the advantage derived from doing a large business. Here is found an inducement to extend business, so that the cost of doing it may be reduced; and here is found an immense corporation, without stockholders and without capital, managed and controlled by the men who contribute to its revenue; a corporation consisting of a large property, paid for by notes and bonds amounting to sixteen million pounds sterling; secured, not by a lien upon the property, but only on its income, and from the payment of which only one hundred thousand pounds sterling can be set aside annually from surplus receipts, if the surplus receipts amount to so much. This loan, though representing the cost of improvements, is really a loan, based solely upon the continued prosperity of the port, and bears interest at rates varying from three per cent per annum, to four and one-half per cent. The sinking-fund with its accumulations amounts to one million two hundred thousand pounds sterling.

The first dock in Liverpool was of three acres, 1,890 yards in extent, and was opened in 1715. In 1800 the dock area had reached 27 acres and 1,912 yards. In 1825 there were 46 acres and 3,179 yards. In 1840 there were 95 acres and 1,954 yards. In 1850 there were 152 acres and 381 yards. In 1857 there were 192 acres and 129 yards. Up to this date, all works had been constructed by the town of Liverpool, under authority of Parliament, and from time to time there had been built upon the Birkenhead side of the Mersey several docks, which on the 1st of January, 1858, had an area of seven acres and 360 yards; so that the total area of

docks upon both sides of the Mersey was 199 acres and 489 yards. At this time was passed the Consolidation Act, by which all the docks upon both sides of the Mersey were placed in the hands of the Mersey Dock and Harbor Board, as perpetual trustees. To the town of Liverpool was allowed the sum of one million five hundred thousand pounds sterling for the surrender of certain rights transferred to the new Board, and such further sum as the town had expended, and to the Birkenhead Dock Company, a sum to be settled as provided by law.

The directors consist of twenty-eight members — eight elected each year, whose term of office is three years — and four members appointed by the Mersey Conservancy Board. The twenty-four members of the Board are chosen from those who, residing within ten miles of Liverpool, have paid dock rates to the extent of twenty-five pounds sterling during the previous year, by those persons who have the same qualifications. In this Board are vested the whole care of the docks, the duties of pilot commissioners for the River Mersey, the duties of harbor commissioners for the river, the exclusive right to build docks, the right to build railroads and to operate them within their own property, and the right to build across (over or under) streets, to discontinue streets, and to make new streets, subject to approval of the town of Liverpool, and to extend railroad tracks to connection with other railroads; and many other rights properly guarded as may be found necessary, and to fix all dock and tonnage rates, harbor and light dues, and rates for pilotage. But they must apply to Parliament for authority to borrow money for farther improvements, and must fix the dock rates at such sum as will pay cost of maintenance, management, operation, interest, and the one hundred thousand pounds sterling for the sinking fund; no portion of the receipts beyond the one hundred thousand pounds sterling per annum being applicable either to a reduction of the debt or further improvements. No member of the Board can receive any compensation for his services, but all employés are paid. Thus it will be seen, that, with increased business, rates must be lessened to the advantage of those doing business in Liverpool.

This is the corporation which now manages and controls all the docks upon the Mersey. In 1860 its dock area was 334 acres, 1,189 yards; in 1870, 383 acres, 811 yards, and in 1880, 433 acres, 4,823 yards. And there are now very great improvements in progress, both at the North and South Ends, the most important of which is the great steam dock at the North End, upon which have been expended one million eight hundred and thirty-six thousand pounds sterling (three hundred and forty-six thousand pounds of it in the year ending July 1, 1880). In this dock there will be three piers or quays, each fifteen hundred feet long, and three hundred feet wide, separated by docks of three hundred feet wide. Upon each quay will be two sheds upon the edge of the docks, each one hundred feet wide, with a street for teams and railroad tracks between them of one hundred feet in width. These quays will add nine thousand feet to the length of quayage, and will be used for the steamers in the American trade, eighteen of the largest of which can be accommodated at one time. Upon these quays will be the hydraulic

cranes, and every other known appliance for the prompt and cheap handling of goods. They are expected to be ready for use in 1881.

In the same dock basin will be graving docks, so that steamers can be repaired promptly, and without moving out of the basin in which they lie to discharge and receive cargo.

At the South End, also, are extensive docks in the course of construction, upon which the sum of three hundred and twelve thousand pounds sterling has been expended, eighty-two thousand pounds of it during the year.

It will be noticed that Liverpool has in construction new docks which have already cost over two million one hundred and fifty thousand pounds sterling, to be added to her present capacity of four hundred and thirty-four acres. The length of dock front upon the Liverpool side of the river is six and one-half miles; and upon the Birkenhead side some one and one-fourth miles, and back from the river about two miles. The total amount expended to 1st July, 1880, has been:—

At Liverpool	£10,727,627	12	7
Birkenhead	5,949,333	6	8
	£16,676,960	19	3
And the debt outstanding is	15,951,248	3	5
So that only	£725,712	15	10

of the cost, or about .0435 per cent, has been paid for.

The rest has been borrowed upon the security of the rates hereafter to be collected. The first dock was opened in 1715, so that in one hundred and sixty-five years the payments for the cost have averaged less than forty-four hundred pounds sterling per year.

The dock receipts were, in —

	Vessels.				Tonnage.
		£	s.	d.	
1752	—	1,776	8	2	—
1775	2,291	5,384	4	9	—
1800	4,746	23,379	13	6	450.060
1825	10,837	128,691	19	8	1,223 820
1840	15,998	178,196	14	0	2,445.708
1850	20,457	211,743	7	7	3,536.337
1860	21,136	397,315	12	11	4,697.238
1870	19,429	511,703	9	8	5,728.504
1880	20,070	706,449	12	8	7,524.533

The above table shows the constant increase of trade at Liverpool, and also shows the effect of the introduction of steam vessels upon their size, the number of vessels in 1850 being greater than in 1880, while in 1880 the tonnage had more than doubled. The dock area had also increased 200 per cent.

Thus I have described the docks at Liverpool, and their system of management. Such system exists nowhere else, I believe. In London,

two great companies, not railroad corporations, but each owning its own tracks to the junction with the great railways, control three hundred and fifty-two acres of dock basins, of which the East and West India Dock Company own and occupy one hundred and twenty-seven acres, and the London and St. Katharine Dock Company two hundred and twenty-five acres. With each other these companies compete for business, and, in order to secure business, each arranges to deliver goods to all the railways upon equal terms. Upon the Continent, the docks are generally under government or municipal control, but in all of the Continental docks opportunity is afforded to all railroads to connect with the dock tracks upon equal terms.

So much I have learned by my visit abroad; and now you will ask me to apply it to Boston, and especially to the property of the State which is in control of the Board.

In the first place, then, let me say that, with the immense trade between Europe and America, Boston can have as much of it as she will prepare herself to accommodate, and that if she will secure to herself, as she can if she will, better facilities and lower rates than at other ports, the business will pour in upon her much faster than she can prepare herself for it. Already, with her imperfect arrangements, and her unfortunate system, there are more steamers in the port than can be accommodated, while the work of proper preparation will take much time. Let then, for the present, every facility be granted to every applicant for increased wharf accommodation. Induce, if you can, adjoining wharf proprietors to unite and make wharves suitable for steamers. Arrange, if possible, for the connection by rail of every wharf where a steamer can be placed with every railroad leading to places from which goods destined for the European market are brought, or to which they are carried.

The value of the property at South Boston, and the value of other wharf-property, will be increased and not diminished by the increase of business, whether that business be done either at the Mystic, at Charlestown, at East Boston, the city proper, or at South Boston; and at whichever point the greatest facilities can be furnished at the lowest charge, there will be the greatest business. It is a business of which there is enough for all, and there should be no rivalry except to excel among the wharf-owners of Boston. The aim should be to make the port of Boston, not East or South Boston only, but the whole port, superior to every other port in its accommodations, and possessed of greater facilities for distributing and collecting cargo, which shall be handled always at lower rates. The Commonwealth can have no rivalry with other wharf-owners. It will take years to put her property in condition to receive steamers or cargoes. If, in the mean while, business is not accommodated here, some other port will take it. If business continues to be done here, it will increase, so that, when the State can get docks upon her property, they will all be needed, and needed, too, more rapidly than they can be supplied. Clearly, then, it is not only the interest of the State, but the duty of the Board, to facilitate in every possible way the building of wharves and docks which will accommodate steamers of the largest size.

In other ports of the world it has been found necessary to make radical changes in the size and depth of docks, and in the arrangements of the piers and the buildings therein, so as to accommodate the necessities of steam navigation; and Boston must do the same thing if she desires to be a port of large trade with steamers. None of the cities in the Old World have escaped this, and the works now in progress in New York show how she is meeting the necessity. Let, then, the wharf-owners commence their work, and I am sure that the Board will aid them to the extent of its powers. Co-operation is the only thing which will change the present harbor front of the city proper into a series of piers and docks suitable for steamer's use. This co-operation should not be delayed. With it much can be done during the next summer to increase the facilities of Boston, and to make wharves, which to-day are of little value, very valuable in themselves, and of great assistance in increasing Boston's importance as a seaport. In East Boston, in South Boston, at Charlestown, both on the Charles and the Mystic, various parties are doing work which should be pushed forward without delay. With all these completed, still more room will be required, some of which, at least, must be found on the State's property at South Boston. To properly improve this, is, as I have said, a work of some years, and none of it can be made ready as soon as it is wanted.

And it is in connection with this property especially that my visit to Europe was made, and for the proper development of it that I have so closely examined and so fully reported the present management of the docks at Liverpool.

The property at South Boston belonging to the Commonwealth consists of some seven hundred acres of unfilled flats, of which perhaps one-half is especially fitted for railroad and shipping purposes. Under the existing laws this Board has the right, with the approval of the Governor and Council, to make "contracts for the improvement, filling, sale, use, or other disposition," of these flats; and an appropriation was made in 1878 for certain expenditures which existing contracts will absorb. An act authorizing the building of a junction railroad to the flats is also in force; but as there is now nothing belonging to the Commonwealth at South Boston except partially filled flats, which it will take much longer to prepare for use than it will to build a railroad, it is hardly probable that a railroad will be built until the lands are more nearly in condition for use. To the further loan of the State credit, even for improvements, there are strong and well-founded objections; and to the grant of even a portion of the land to parties who might make a large profit upon it there is also a strong objection. Yet the land remains, and, that there will be a demand for it as soon as it can be made ready for use, seems beyond question. If any corporation now authorized could be made a perpetual trustee, or if, in the absence of such corporation, a trust could be created, which should be authorized, the fee of the land remaining in the State, to borrow money upon improvements which should always be devoted to commerce, somewhat upon the basis of the Mersey Docks, and the management, like that of the Mersey Docks, to be in the hands of those who contribute to its revenues, and with such other provisions

as would insure the reduction of charges as business increased, with no interest to be earned upon the cost or value of the land, but only revenue enough to pay the interest upon the cost of the improvements made, and the necessary expenses for operating and maintenance, the required improvements could be made without a donation of land, without the further issue of the State's credit, and without appropriations from the State treasury, provided the money for the proposed improvements could be obtained upon the same kind of security for improvements in Boston, as money is now and for many years has been obtained for improvements in Liverpool. This security is nominally the rentals of docks and piers, and the amount loaned is their cost; but the real security is the continuance of the great commercial trade of the port. While Liverpool continues a commercial port, there is confidence that a rental will be received, sufficient, at rates which will retain commerce against all competition, to pay the cost of maintaining and operating the docks there in addition to the interest upon their immense cost of nearly one hundred millions of dollars. If the same confidence exists as to the permanency of Boston's increasing commerce, there would seem to be no question of the ability of docks and piers, which pay no interest upon the cost of the land, paying an interest upon the cost of the improvements thereon, in competition with other docks and piers which must earn an interest upon the cost of both the land and the improvements, and therefore but little question as to the possibility of borrowing money in this country for all improvements which might be required from time to time. But, if there should be doubt about the loan being made here, I have good reason to believe that the money could be had in Great Britain, and probably at a low rate. There are two special advantages in this plan, besides those named: first, it devotes to trade permanently a large tract which can be utilized at the lowest possible rate for all time, and is therefore a benefit to both city and State; and, second, it will make the rest of the State property at South Boston of largely increased value.

Sometimes it is said that business passing through a place as it does through Liverpool, and will through Boston, is of no material benefit. Still, in Liverpool the Dock Board employ many thousand men, representing probably thirty thousand inhabitants of the city, who are paid directly from the revenue of the docks, besides which are the many men employed by the railroads in handling the merchandise received from or carried to the docks, which together represent a population occupying many houses, and requiring many tradesmen to supply their various needs; all of which business, besides the employment of the many men connected with the shipping, which, in its turn, employs many tradesmen, mechanics, merchants, and bankers, may be traced directly to the docks.

Such are the benefits of the adoption of the Mersey system in Liverpool; and, if my suggestions shall meet the views of the Board, I trust that such legislation may be recommended and secured as may enable work to be commenced and carried forward at South Boston upon a basis which, while it increases the value of the property of the State, will secure to Boston all the business which it can do with ships, and will enable her also, for all time, to do it at the lowest possible rates. If

this can be accomplished, even in a small degree, I shall feel that the time spent upon my trip has not been wholly wasted.

In conclusion, I desire to express my thanks especially to Messrs. George Warren & Co. of Liverpool, who were untiring in their efforts to secure to me all the information I desired ; to Mr. Lyster, the engineer of the Mersey Docks, for his many courtesies, and for the time, information, and introductions which he secured to me; to Mr. Gittins, the secretary of the Liverpool Docks, for the valuable collection of documents furnished to me ; to Mr. Forrest, the secretary of the Society of Civil Engineers in Europe, for his many courtesies, and especially for his letters of introduction to the engineers of the several ports which I visited; to the resident engineers of these several ports, for their kindness in furnishing me with every desired information; and to the various commercial houses and government officials who assisted me so much in my many inquiries.

WILLARD P. PHILLIPS.

Boston, December, 1880.

From this report, it is evident that many of the principal ports in Europe are actively at work in preparing docks suited to the requirements of the large steamers engaged in the American trade, the extent of which is shown in part by the large proportion of the whole trade at Liverpool; and the returns from the Liverpool docks show how largely the average size of ships has increased since the introduction of steam. All docks, therefore, which are intended for steamers should probably be at least as wide, and the piers as commodious, as those now building at Liverpool.

We agree with the views expressed in the report as to the probable extent of the trade in Boston if the proper facilities are furnished. We agree, too, in the suggestion that wharf-owners in Boston should secure, by co-operation and without delay, wharves suited for the accommodation of steamers. We agree, too, that the Board should aid by every means in its power the construction of new and the enlargement of old wharves. And we believe that all this will but add to the necessity of the rapid development of the property at South Boston.

We join, too, in the recommendation of the report that the attention of both the legislature and the merchants of Boston should be directed to the necessity of providing for the connection of all railroads with both the existing docks and with all new docks built, so as to add to the advantages and facilities of the port.

We have been especially interested in the report of the system of management of the Liverpool docks. It is a system which secures to commerce the lowest possible charges, every requisite convenience, and permanency. If it could be adopted here, it would place the control of business in the hands of the merchants themselves, and could not but add materially to the value of the Commonwealth's property at South Boston, even if one-half of it should be placed in a perpetual trust for the benefit of trade which it would constantly increase and develop. It would also avoid the use of the State's credit, and would make unnecessary any further appropriations. And we recommend such legislation as may be needed to make a perpetual trust, in whose hands should be placed such portion of the South Boston Flats as may be required and suitable for dock purposes, and that to such trust should be given such powers to borrow money for improvements, as the legislature may from time to time authorize, with the further authority to issue bonds secured by future rentals, with all necessary and proper restrictions. In the trust the State should be represented, as is the Conservancy of the Mersey in the Liverpool trust. The qualification of members of the board of directors should also be properly guarded. In the framing of such a bill very great care should be used, and it is very probable that even with all this care there would be some alteration or additional provision required before the lenders of money would be fully satisfied. This might cause the delay of a year, and cannot be afforded. Time is too valuable. While therefore we recommend such legislation, and most heartily approve of it, we also recommend further appropriations for the energetic continuance of work at South Boston. If the trust shall be created, and shall assume control of the South Boston property, the money expended by the State in improvements would be reimbursed from the proceeds of the first bonds issued; and that should be one of the conditions precedent of the trust. If these recommendations shall be followed, there need be no delay either in the formation of the trust or in the progress of the work of reclamation, and every thing will have been done which can be to prepare the State's property for the great business which will pour in upon it if it is seasonably prepared to receive it.

BACK BAY LANDS.

	FEET.
In 1857 there belonged to the Commonwealth, in the Back Bay, so called	4,723,998
Of which there have been donated or transferred, —	
as per last report	314,740
In 1880	48,568
	<hr/> 363,308
Devoted to streets and passage-ways, as per last report	2,037,063.6
Sold, as per last report	2,084,931.6
in 1880	110,857.45
	<hr/> 2,195,789.05
Remaining on hand Dec. 31, 1880	127,832.35
	<hr/> <u>4,723,998</u>
The gross proceeds of land sold have been as per last report	\$4,307,722 17
In 1880	315,361 85
	<hr/> \$4,623,087 02
Rights in Parker Street sold as per last report	\$2,200 00
In 1880	100 00
	<hr/> 2,300 00
	<hr/> <u>\$4,625,387 02</u>
Cost of filling, grading, &c., as per last report	\$1,626,008 71
auction sales, as per last report	14,291 78
	<hr/> 1,640,300 49
	<hr/> <u>\$2,985,086 53</u>
Net proceeds to Dec. 31, 1880	\$2,985,086 53

Of the whole land belonging to the State in 1857, only 46.48 per cent has been sold; the remainder, except 127,832.35 feet (2.706 per cent), having been given away or used in streets. The State has already received a net profit of 63.19 cents for every square foot owned by it in 1857; and the 2,195,789.05 feet already sold have averaged \$2.1054 per square foot gross; and, after deducting all the expenses of filling, the 4,723,998 feet have yielded a net profit of \$2,985,086.53, or \$1.3594 per square foot sold.

The land sold during the year, and its location, is as follows: —

18 HARBOR AND LAND COMMISSIONERS. [Jan.

Area in sq. ft.	LOCATION.	Amount.
2,800. .	Marlborough Street, north side . . .	\$9,800 00
25,345.6 .	Marlborough Street, south side . . .	69,700 40
9,810.6 .	Commonwealth Avenue, north side . . .	44,147 70
9,773.25 .	Commonwealth Avenue, south side . . .	37,536 75
14,224. .	Newbury Street, north side . . .	29,120 00
5,152. .	Newbury Street, south side . . .	10,304 00
10,752. .	Boylston Street, north side . . .	32,256 00
33,000. .	Boylston Street, south side . . .	82,500 00
110,857.45	square feet, at an average of \$2.8447 . . . Lowest price, \$2; highest price, \$5.	\$315,364 85

The prices show a general improvement upon the prices obtained last year; and, with the continued advance in the value of the land, it is expected that still higher prices will be obtained for the remainder.

Upon the sales of the land there was no charge of brokerage, the Commissioners having made the sales directly to the purchasers.

The land donated in 1880 was, —

	FEET.
To the city of Boston, for Public Library on Boylston Street, corner Dartmouth	33,000
To the State Normal Art School, Newbury Street, corner of Exeter	15,568
	<hr/> 48,568

The value of which was at least \$150,000.

The land still unsold is all beyond Dartmouth, and is located as follows, viz.: —

	FEET.
Marlborough Street (north side)	19,577.6
Commonwealth Avenue (south side)	6,411.75
Newbury Street (north side)	31,584
“ “ (south side)	26,208
	<hr/> 57,792
Boylston Street (north side)	36,176
“ “ (south side)	7,875
	<hr/> 44,051
Total square feet	<hr/> 127,832.35

The value of this remaining land must be over \$300,000.

RECEIVED FROM TIDE LANDS.

There has been received during the year, under Chap. 284 of the Acts of 1874, for land of the Commonwealth occupied by wharves or other structures in tide-water, the sum of \$27,484.82; and one or more licenses are pending, wherein the amount to be paid is not yet determined.

CHARLES RIVER BASIN.

In view of the various projects for encroachment upon Charles River Basin, and the fact that the harbor-line on the Cambridge side had been the subject of careful revision in 1878, it was deemed inexpedient to include that area in the re-statement of harbor-lines made last year. There are, however, many reasons why the policy which is to govern the treatment of this portion of the harbor should be definitely determined. The city of Boston has asked, and its application is now pending before the legislature, for a strip two hundred feet wide on the Boston side, extending from Cragie's Bridge to a point nearly opposite the junction of Brookline Avenue with Beacon Street, to be occupied for park purposes. The owners of flats on the Cambridge side desire to occupy to the present harbor-line for building purposes, and to enhance the value of their land within the line, by improving a strip outside the line two hundred feet wide for park purposes, in harmony with the plans of the Park Commissioners on the Boston side. Chap. 25 of the Resolves of 1878 gave certain powers to the Land Commissioners which plainly contemplated reclaiming a part of the Commonwealth's portion of the basin for sale as land. Every consideration affecting navigation, health, or the comfort and beauty of the locality, demands that so much of the basin as is not to be reclaimed should be deepened; and, that no work to this end may be wasted, it is important to know just what is to remain open. The area between West Boston Bridge and Brookline, which forms the upper basin, comprises about six hundred and forty-six acres; of which two hundred and forty-nine acres are the property of the Commonwealth, about three hundred and thirty-four acres belong to riparian owners on the Cambridge side, and the remaining sixty-three acres to private parties on the Boston

side. The average width opposite the Mill-Dam is about thirty-four hundred feet. If filling is permitted to the present harbor-lines and no encroachment permitted beyond those lines, the open basin will then contain about four hundred and thirty acres, or two-thirds the present area, of which the Commonwealth will still own two hundred and forty-nine acres, the riparian owners on the Cambridge side one hundred and fifty-five acres, and the riparian owners on the Boston side twenty-six acres. The basin would then be about twenty-three hundred feet wide, measuring opposite Fairfield Street.

All private ownership in the land covered by the basin, except in a few instances on the Boston side where rights to fill have already been granted, is subject to the public right of flowage by tide-water; and there is no obligation to relinquish this right of flowage save as the public interests may be served thereby. This is true of the area within the harbor-lines, as well as of the area without those lines.

Encroachment upon the area of tide-water, which could not be permitted for the purpose of promoting private gain, may sometimes be wisely allowed for public purposes, as for the promotion of the public health, or facilitating public travel. Gain to the public treasury is a public benefit which it is legitimate to weigh against public advantages surrendered. As a large expenditure of public money would be unwise to secure a small advantage to the harbor, so a large gain to the public treasury may be wisely secured by concessions which involve but slight disadvantage. To justify encroachment upon a natural provision for one public purpose, to secure another public object, it should, however, be very clear that the advantage to be secured outweighs the disadvantage involved; and all presumptions in case of doubt should be in favor of preserving natural advantages.

If the cost of converting a strip two hundred feet wide on the Boston side of the basin into a satisfactory park will equal the value of such park when constructed, then there is no gain to the public from such encroachment. Nearly one-half the sea-wall which would be required to retain the proposed embankment in the upper basin must be built in deep water, in the main channel, at large cost; and a considerable part of the filling occasioned would be in the deepest

part of the basin. Whether the money required to construct the embankment, even if the land were given, would not do more for park purposes in the purchase of land requiring less change to adapt it to such use, is a question for the city only, except so far as it may assist us to determine the importance of the public benefit to be secured by surrendering this portion of the basin for such use. It ought to be stated, that the portion in question is not now, or likely to become, a nuisance: nearly one-half of what lies in the upper basin is now deep water, and the remainder is that, the deepening of which will be most readily secured; while in the lower basin, all the area which it is proposed to occupy for the embankment is covered by a fair depth of water at all stages of the tide.

It would be difficult to estimate very closely what might be realized to the public treasury by reclaiming a portion of the Commonwealth's land on the Boston side of the basin for sale as land. The Board recognize that it is as incumbent upon them to study the property interest which the State has in the basin, as it is to ascertain the advantage or disadvantage to the harbor which may follow changes therein. If the reclamation of a single row of building-lots, extending from Arlington Street to the western end of the Mill-Dam, could be effected in connection with the park occupation, making the embankment perhaps three hundred and ten feet outside the present harbor-line instead of two hundred feet, it would not be unreasonable to anticipate a profit to the treasury of from seven hundred and fifty thousand dollars to one million dollars, according to the prices which should be obtained for the land sold. If the reclamation were made independent of co-operation by the city, sufficient land being filled for one row of lots, with a wide ornamented street in front, on the border of the basin, the profit would not be large; and in view of the depth of water, and the large cost of the sea-wall, it is not certain that such independent reclamation could be advantageously undertaken, aside from the question of its effect upon the harbor.

The filling which the riparian owners on the Cambridge side desire to make, is upon flats of which they own the fee. No grant of land is involved; but the surrender of the right of flowage might be as important to the public as a grant of

land, and cannot be made thoughtlessly. The authority to fill would hardly be granted, and probably would not be asked, without compensation in some form for the tide-water to be displaced. It is proposed that compensation be made by filling with material dredged from the basin. The material forming the bed of the basin is believed to be in large part equal to gravel from the country, and it is probably practicable to make the entire filling with dredged material; but, making some allowance for inequality of depths, which may be necessary to secure the required quantity of the best material, it is more prudent to estimate that only the amount of material needed to raise the reclaimed land to grade ten can be counted effective for securing a uniform depth in the basin. On this basis, if the Cambridge flats are reclaimed to the harbor-line, and no encroachment on the Boston side is permitted beyond the existing harbor-line, the bed of the basin remaining will be dredged to grade four below mean low water, thus giving at ordinary low water a minimum depth of four feet, and at low water of extreme spring tides a minimum depth of two feet, with considerable portions of the basin much deeper. This is probably sufficient to remove all danger to health, and all annoyance from offensive odors; and opportunity would be likely to occur from time to time to obtain other dredging. The Board would hope that a depth of twelve feet might be eventually obtained. No legislation is required to authorize filling to the harbor-line, as the general laws are sufficient; but the proprietors say that the proper development of their land will require the devotion of a part of it on the border of the basin to ornamental purposes, and that the cost of reclamation is so large, that the amount of land available for sale will not be sufficient to make it certain that their enterprise would result advantageously. They also say that a strip two hundred feet wide beyond the harbor-line can be enclosed with no increase of expense for the sea-wall, and that if they can be allowed to occupy such strip solely for park purposes, in harmony with the plans of the Park Commissioners on the Boston side, it would materially aid their enterprise. It would in no case be admissible to permit such occupation in the narrow neck of the basin, immediately below Brookline Bridge; but, if it were permitted from the point where

the space between the harbor-lines begins to widen materially to West Boston Bridge, the area of the basin which would then remain would be about three hundred and ninety-six acres, and the minimum depth of water would be increased about eighteen inches, making five feet six inches at ordinary low water. The park gained by such extension would have this advantage over that proposed on the Boston side, that it would be secured to the public with no expenditure of public money at the outset in its construction, and it would occupy what is now the shoal part of the basin, instead of what is the deepest. If this extension is granted, it will render much more objectionable that proposed on the Boston side. If the park embankment on the Boston side is permitted, and that on the Cambridge side refused, the area of the upper basin, which would then remain, would be about three hundred and ninety acres, and the minimum depth would be increased about two feet, giving six feet at ordinary low water. If both were permitted, the width of the basin would be reduced to nineteen hundred feet opposite Fairfield Street, its area to about three hundred and fifty-six acres, and its minimum depth increased to nearly eight feet at ordinary low water. It is of course assumed that no filling will be permitted unless dredging is required in connection with it.

The relative importance of the different public interests involved must be determined by the legislature; but on a careful study of the interests of the harbor, which it is the province of this Board to protect, it does not seem admissible to permit any encroachment upon the area of either basin beyond the present harbor-line, except as already provided by statute, to abate a nuisance at the abrupt angle in the line on the Boston side. If the desired deepening of the whole basin could be secured within a reasonable time, the Board would incline to preserve it intact; but it is not clear that this could be accomplished within the time which the public would be willing to endure the flats in their present condition. If the Board were re-stating the harbor-line on the Boston side, they would make a curve at one point where now there is an abrupt angle; but the only purpose of making such change is fully answered by Chap. 247 of the Acts of 1866, which permits the city of Boston to oc-

cupy in said angle to a curve therein described, and to appropriate the land so reclaimed for ornamental grounds or for a street, and otherwise they would advise no change in the line on either side.

The Board do not wish to exaggerate the effect upon the harbor to be anticipated from filling any part of these basins. It is easy to overstate the mischief that would follow, and it is quite possible that it has been overstated in the earlier discussion of the value and functions of the interior basins of Boston Harbor; but, after making all reasonable concession for over-statement and zeal on the part of advocates of special scientific theories, the sober judgment of all who are familiar with the discussion and with the experience in the important harbors of the Old World must be, that the value of these interior basins is very great, and their preservation very important. At no time in the history of Boston has the importance of its harbor to its future growth, and through its growth to the growth of the State, been more apparent than now. The magnitude of the foreign commerce which the country is certain to have, and the share of it which Boston may reasonably expect to obtain, is but just beginning to be outlined; but enough is already seen by all who have given the subject attention to make it clear that we cannot wisely be indifferent to any causes which may impair, in even a slight degree, the excellence of its harbor. The value of tidal reservoirs as aids in securing and maintaining the desired depth of water at points below such reservoirs is receiving increased attention in the ports of the world which are now making the largest expenditure to meet the demands of modern commerce; and there should be great caution in relinquishing any advantage which the harbor of Boston possesses in this direction. The basins of the Charles River are the most valuable of the reservoirs which remain. A large reservoir capacity at Prison Point Bay has been surrendered for the abatement of a nuisance to the public health, and it seems the more desirable to retain all of that which remains which it is possible to retain. The filling which may be authorized in the upper basin within the existing harbor-lines will reduce its capacity as a tidal reservoir 2,319,140 cubic yards; the strip which the Cambridge proprietors desire to improve outside the line, not continued into the neck of the basin, would

reduce it further 550,865 cubic yards; and the embankment desired by the Park Commissioners on the Boston side would effect a reduction of 643,000 cubic yards. It should be remembered that these quantities do not fully measure the loss, as the tide-water which lies at the highest plane here is the most effective in its work below, and the loss which will follow these encroachments, particularly upon the Cambridge side, is of tidal volume which lies at the higher plane, while the partial compensation made by dredging is of tidal volume at a lower plane. The obstructions of the outlet to these basins have seriously impaired the value of the reservoirs in question, and complicate the problem of their treatment; but it is not impossible that these obstructions may be much modified in the future, so that the power of the tidal flow may be more fully realized. It should increase the caution with which any portion of the interior reservoirs are given up, that the dredging in the harbor below has very much increased the area of channel depth to be maintained, and this will be still further increased in future. As the work which the flow of the tides is expected to perform is increased, there should be care taken that their volume is increased rather than diminished.

The proprietors on the Cambridge side desire that they may be authorized to build a bridge to the Boston side between the Brookline and West Boston Bridges. It is probable that a bridge at this locality will be required, and authority has once been given to the two cities to build one by Chap. 314 of the Acts of 1874; but this authority has expired. If it is thought wise to renew the authority, or to give it to other parties, or to allow this Board to do so, legislation would be necessary.

The opinion of Professor Henry L. Whiting upon the physical consequences of the proposed encroachments was sought by the Board in its study of the question; and his report will be found in the Appendix.

HARBOR-LINES AT EAST BOSTON.

The harbor-line at East Boston was established by Chap. 35 of the Acts of 1840, and from time to time parties were authorized to extend their wharves to the harbor-line. Prior to 1866 there was no Board to supervise the construction of

the wharves authorized, and each party ascertained the position of the harbor-line for himself. It has resulted that a number of wharves, now ancient, are in fact beyond the harbor-line; and some which the owners desire to extend to the line of the wharves upon either side of them cannot be so extended, because the harbor-line is in fact within the line which has been acted upon as the true line. The extensive plans for development of the more easterly part of the East Boston frontage which were known to be in progress led the Board to delay a re-statement of the line upon that side of the harbor, in connection with that established upon the frontage of the city proper by the Act of 1880. The Board are still unprepared to recommend a line for the whole frontage; but the difficulties which have recently come to their knowledge, in connection with the position of old wharves in relation to the existing line, has led them to consider whether it might not be wise to repeal the existing line, and leave that frontage without a harbor-line till the studies are ripe for a comprehensive treatment of the whole. The practical effect would not be as serious as formerly, as under existing laws licenses for structures may be given where there is no harbor-line; but, in lieu of the restriction of the established line, such licenses must have the approval of the Governor and Council.

The Boston and Albany Railroad Company desire to extend piers beyond the present harbor-line to a point in line with the other piers at their terminal grounds. Such extension would cross a channel by which wharves lying easterly are now approached; but the railroad company are willing to excavate a channel of equal capacity through the shoal lying outside, and the Board are advised by experts that the currents are not such at this point that any physical injury to the harbor would result from turning the channel as desired. The extension would furnish accommodation much needed, and the Board desire to grant it if upon full study there shall appear no insuperable obstacles. If the entire harbor-line at East Boston should be repealed, as above suggested, no other legislation would be requisite to permit this extension; but if the line should remain as now established, the Board recommend the passage of the bill for this purpose, given in the Appendix.

RE-SURVEY OF BOSTON UPPER HARBOR.

In addition to the points of triangulation determined by the work of Mr. Francis Blake, jun., of the United States Coast and Geodetic Survey, and given in a list of geographical positions, together with his report in the Appendix of the Report of the Board for 1875, a further determination by triangulation has been made, under the direction of the Board, by Mr. William E. McClintock, of the initial points in the harbor-line of so much of the frontage as has been included in the topographical survey. A list of these geographical positions will be found in the Appendix in the form heretofore presented, which is uniform with that adopted by the Coast Survey. All additional data for determining the relative positions of wharves in reference to the established harbor-line will be furnished, on application, from the archives of the Board.

COMPENSATION OF THE BOARD.

The members of the Board feel very strongly that the provision of law for their compensation is inadequate for the service which the position requires. With the consolidation of work formerly in charge of separate boards, the duties have ceased to be occasional, and demand daily attention from all the members. While it was not expected that the entire time should be given, it is found practically that there is very little time that can be given to private business which is not subject to frequent interruption from the necessary demands of the public work. If the *per diem* measure of the service was best while the work was in large degree experimental, it has ceased to be even approximately just. The time and character of service vary from attention to pure routine work for two or three hours, to the closest application to matters responsible and exhausting, continued through the entire day and late into the night. Whatever is deemed the proper compensation of the Board, it would seem more just and fitting that it should be measured by annual salaries. The questions with which the Board has to deal demand a quality of service that is entitled to liberal compensation. If they do not have this, it ought to be made possible to secure it. The aggregate transactions

of the Board are of sufficient pecuniary consequence to the Commonwealth to make it important that such service be had, as the indirect cost of inefficient service may be very large. It seems a plain duty to present these views for such action as may be thought proper: if sound, they concern the efficiency of the Board, and thus the interest of the Commonwealth, more than the personal interest of any member.

SPECIAL COMPENSATION.

The amount of special and exceptional work which was devolved upon the present Board during its first official year was so large, that it seems to the Board just that special provision should be made therefor.

A large amount of time was occupied in connection with hearings before referees upon the claim of Clapp and Ballou. The active demand for land upon the Back Bay which began in October, 1879, required close attention and much time from all the members. The sales amounted to \$556,652.35, and were effected entirely without the payment of commissions to brokers or auctioneers. Special duties with the Railroad Commissioners under Chap. 45 of the Resolves of 1879 also claimed considerable time. The more important special service growing out of negotiations relating to the land at South Boston, and the protracted hearing before the legislative committee arising out of one phase of those negotiations, involved a large amount of labor. Much of this work was professional in character, and all of it was responsible and exhausting. The hearing resulted in a sale under Chap. 260 of the Acts of 1880, amounting to \$1,108,165. There is no provision under which any allowance can be made for extra or professional service by members of the Board, nor would they suggest such provision for any moderate amount of such service; but the extent of that in question exceeds what can with justice to themselves be rendered without a request for compensation. It would seem to be in keeping with existing legislation to authorize the Governor and Council to allow such sum as should appear to them reasonable, subject to such limit as to amount as may be thought proper.

OFFICE AND FIELD WORK.

During the last year the operations of the Board connected with harbors and tide-waters have been in excess of those in any previous year. The number of licenses granted have also been larger than heretofore issued in one year. The demand for maritime facilities in Boston Harbor continues in about the same proportion with that in other harbors and coast localities; the applications for authority to build wharves and other structures in Boston Harbor being about one-fourth of the number presented. In connection with these improvements, the attention of the Board has been called to most of the harbors of the Commonwealth.

The following statistics, in the usual form, show the particulars of the work:—

Plans approved by the Board of Harbor and Land Commissioners during the Year 1880, for the Erection of Structures in and over Tide-water, and Licenses granted for such Structures.

Nos.

512. Kidder, Vaughan, & Co., for leave to construct a wharf in Chelsea Creek, East Boston. Approved Jan. 15, 1880.
513. Henry S. Sterling, for leave to extend his wharf at North Pocasset Buzzard's Bay. Approved Jan. 29, 1880.
514. Old Colony Railroad Company, for leave to widen its drawbridge and extend its draw-piers over Neponset River. Approved Feb. 5, 1880.
515. John C. Rhodes, for leave to construct a solid wharf at Mattapoissett. Approved Feb. 19, 1880.
516. George Curtis, for leave to straighten the line of his wharf in Roxbury Canal. Approved Feb. 27, 1880.
517. A Cochrane & Co., for leave to extend their wharf on Mystic River. Approved March 4, 1880.
518. William Rackliff, for leave to extend his wharf at "Oak's Cove," Gloucester Harbor. Approved March 18, 1880.
519. L. G. Burnham and others, for leave to build bridges across Dean's and Hog Island Rivers, in the town of Essex. Approved March 18, 1880.
520. Fitchburg Railroad Company, for leave to fill land and flats between its road and Eastern Railroad, in the city of Somerville. Approved March 18, 1880.
521. Boston and Albany Railroad, for leave to cover with a pile structure Dock No. 7, and extend Pier No. 7 of Grand Junction Wharves, East Boston. Approved March 25, 1880.
522. R. W. Bowles, for leave to construct a wharf at Mattapoissett. Approved April 29, 1880.

30 HARBOR AND LAND COMMISSIONERS. [Jan.

Nos.

523. William Hale, for leave to extend his wharf on Merrimac River, Haverhill. Approved April 1, 1880.
524. Haverhill Steamboat Express Company, for leave to place a floating wharf on Merrimac River, near Salisbury Point. Approved April 7, 1880.
525. Edward P. Shaw, for leave to place a floating landing on Merrimac River, near Salisbury Point. Approved April 7, 1880.
526. New Bedford Yacht Club, for leave to construct a pile wharf near Pope's Island, New Bedford Harbor. Approved April 7, 1880.
527. George Perkins and William H. Perkins, jun, for leave to extend their wharves in Gloucester Harbor. Approved April 22, 1880.
528. Town of Dennis, for leave to construct a solid roadway across Sesuit Creek. Approved April 22, 1880.
529. Henry S. Sterling, for leave to extend his wharf at North Pocasset, Buzzard's Bay. Approved May 6, 1880.
530. Fitchburg Railroad Company, for leave to build an addition to its Miller's River freight-yard. Approved May 6, 1880.
531. Fitchburg Railroad Company, for leave to construct a bridge in Miller's River, to connect its freight-yard with Prison Point Bridge and Austin Street. Approved Sept. 4, 1880.
532. Horatio and J. A. Wellington, for leave to fill their dock west of Bridge Street, East Cambridge. Approved May 6, 1880.
533. Foster's Wharf Company, for leave to straighten the easterly side of its wharf on Fort Point Channel. Approved June 24, 1880.
534. City of Boston, for leave to rebuild a portion of Chelsea Bridge. Approved May 13, 1880.
535. Charles A. Ropes, for leave to extend his wharf on South River, Salem Harbor. Approved May 20, 1880.
536. James N. Buffum & Co., for leave to extend their wharf in Lynn Harbor. Approved May 20, 1880.
537. Robert Scott, for leave to drive piles to define the Commissioners' line on South Boston Point. Approved May 27, 1880.
538. Boston and Albany Railroad Company, for leave to construct an additional drawbridge over Broad Canal, East Cambridge. Approved June 9, 1880.
539. Fitchburg Railroad Company, for leave to fill land and flats in Miller's River, Charlestown District. Approved June 3, 1880.
540. Henry D. Baxter, for leave to construct a boat-pier at Hyannisport. Approved June 7, 1880.
541. Board of Health of the Town of Swampscott, for leave to extend its drains on Blaney's Beach, Swampscott. Approved June 10, 1880.
542. William F. Green & Son, for leave to extend their wharf on Border Street, East Boston. Approved June 10, 1880.
543. Charles L. Pearson, for leave to rebuild and extend his wharf on Fort Point Channel, Boston. Approved June 10, 1880.
544. Lynn and Boston Railroad Company, for leave to build a temporary bridge in Mystic River. Approved June 10, 1880.
545. M. A. H. Procter, for leave to build a wharf at Plum Island, Ipswich. Approved June 17, 1880.

Nos.

546. Thomas McKinney, for leave to build a wharf on the west side of Grape Island, Ipswich. Approved June 17, 1880.
547. City of Lynn, for leave to extend and enlarge the "Engine House" lot on Broad Street, Lynn. Approved June 17, 1880.
548. William C. Poland & Son, for leave to construct a wharf at Moon Island, Boston Harbor. Approved July 12, 1880.
549. Boston Tow Boat Company, for leave to build a pile pier at East Boston. Approved July 22, 1880.
550. City of Cambridge, for leave to build a pile structure across Charles River for the support of a water-pipe. Approved July 29, 1880.
551. Joseph F. Paul, for leave to fill solid part of his wharf near Dover-street Bridge. Approved July 29, 1880.
552. Boston and Albany Railroad Company, for leave to widen Pier No. 7, and deepen Dock No. 8, Grand Junction Wharves, East Boston. Approved July 29, 1880.
553. City of Haverhill, for leave to improve the draw-ways of Rock's and Groveland Bridges across Merrimac River. Approved July 29, 1880.
554. Lynn and Boston Railroad Company, for leave to build a temporary bridge in Mystic River, north of north draw of Chelsea Bridge. Approved July 22, 1880.
555. New York and New England Railroad Company, for leave to build a platform in the Boston and Albany Railroad Company's Dock at South Boston. Approved Aug. 5, 1880.
556. City of Chelsea, for leave to rebuild its part of Chelsea Bridge. Approved Aug. 12, 1880.
557. Eastern Railroad Company, for leave to fill solid Mill Creek Bridge on the line of its road in Essex. Approved Aug. 12, 1880.
558. Pasque Island Corporation, for leave to construct a wharf at Pasque Island, town of Gosnold. Approved Aug. 19, 1880.
559. Gosnold Mills Corporation, for leave to extend its wharf in New Bedford Harbor. Approved Aug. 26, 1880.
560. Eastern Railroad Company, for leave to fill solid its main track between Austin Street and the crossing of the Fitchburg Railroad, Charlestown District. Approved Sept. 2, 1880.
561. Hull and Nantasket Beach Railroad, for leave to construct its road across tide-water in the town of Hull. Approved Sept. 16, 1880.
562. City of Boston, for leave to construct a temporary dam in South Bay. Approved Sept. 16, 1880.
563. Mary J. Healey, for leave to construct a pile wharf in Dorchester Bay. Approved Sept. 16, 1880.
564. Washington Allen, for leave to build a stone pier on Scraggy Neck in Sandwich. Approved Oct. 12, 1880.
565. Edward P. Shaw, for leave to place a floating landing on Merrimac River, near Salisbury Point. Approved Sept. 23, 1880.
566. Butchers' Slaughtering and Melting Association, for leave to build a sea-wall and fill flats on Charles River, Brighton District. Approved Sept. 30, 1880.
567. Proprietors of Tide Meadows in the town of Salisbury, for leave to

32 HARBOR AND LAND COMMISSIONERS. [Jan.

Nos.

- fill solid two bridges on the line of the Eastern Railroad. Approved Sept. 30, 1880.
568. John Gary and the heirs of John Wesson and Abel Fitz, for leave to extend Tuft's Wharf on Charles River, Charlestown District. Approved Nov. 4, 1880.
569. Francis E. Foster, for leave to re-construct his wharf on Mystic River, Medford. Approved Oct. 8, 1880.
570. Salem and Magnolia Steamboat Company, for leave to construct a wharf on Salem Neck, Salem Harbor. Approved Oct. 8, 1880.
571. Salem Bay Yacht Club, for leave to construct a wharf on Salem Neck, Salem Harbor. Approved Oct. 8, 1880.
572. Standard Sugar Refinery, for leave to extend its wharf on Fort Point Channel, South Boston. Approved Nov. 11, 1880.
573. Revere Beach Land Company, for leave to construct a bulkhead, and fill the area enclosed by the same near Cherry Island Bar, Revere. Approved Nov. 18, 1880.
574. Fitchburg Railroad Company, for leave to extend its wharf on Charles River, Charlestown District. Approved Nov. 27, 1880.
575. Boston and Albany Railroad Company, for leave to extend its Dock No. 3, Grand Junction Wharves, East Boston. Approved Dec. 9, 1880.
576. Benjamin Low, for leave to extend his wharf in Gloucester Harbor. Approved Dec. 9, 1880.
577. Thomas B. Tripp, for leave to construct a wharf in Clark's Cove. Approved Dec. 13, 1880.
578. Andrew W. Dodd, for leave to extend wharf in "Vincent Cove," Gloucester Harbor. Approved Dec. 23, 1880.
579. Benjamin F. Cook, for leave to extend his wharf in "Vincent Cove," Gloucester Harbor. Approved Dec. 23, 1880.
580. Heirs of William Collins, for leave to extend their wharf in "Vincent Cove," Gloucester Harbor. Approved Dec. 23, 1880.
581. Chresten Nelson, for leave to extend his wharf in "Vincent Cove," Gloucester Harbor. Approved Dec. 23, 1880.
582. Ellerton L. Dorr, for leave to construct a wharf on Peters Neck, town of Wareham. Approved Dec. 23, 1880.
583. George Peabody, for leave to extend Fiske's Wharf to harbor line, Boston Harbor. Approved Dec. 31, 1880.
584. John McKinnon, for leave to build a wharf on Belle Isle Creek, East Boston. Approved Dec. 31, 1880.
585. Pacific Guano Company, for leave to extend its wharves at Woods Holl, Town of Falmouth. Approved Dec. 31, 1880.
586. Boston and Albany Railroad Company, for leave to rebuild sea-wall in Dock No. 6, Grand Junction Wharves, East Boston. Approved Dec. 31, 1880.

HARBOR IMPROVEMENTS BY THE GENERAL GOVERNMENT.

The work of the General Government in the harbors and rivers of the Commonwealth during the year have been of unusual interest and importance. That in the section north of Cape Cod has been in charge of Gen. Thom, and that in the section south of Cape Cod in charge of Gen. Warren. These officers have at the request of the Board kindly furnished detailed accounts of the operations in their charge, which will be found in the Appendix, and to which attention is called.

The great improvements which have been accomplished under the liberal policy of the General Government, not alone in Boston Harbor, but in the rivers and smaller harbors of the Commonwealth, cannot fail to have a marked effect upon the prosperity of the State. The projected works on the Merrimac and Charles Rivers at Nantucket, Woods Holl, and Wareham, are worthy of attention and encouragement on the part of the State.

The plan of opening the Connecticut River for navigation, with a depth of eight feet to Holyoke, and the possible extension of navigation still further up the river, deals with what is not tide-water, nor yet a harbor, but the Board venture to commend the measure as one of much practical importance to the Commonwealth.

The people of Edgartown have been with good cause much interested in the consequences to their harbor from the closing of the inlet through Cotamy Beach, and are moving to secure the renewal of efforts by the General Government to re-open this inlet. The Board desire to second heartily this movement, and will co-operate with the efforts being made to secure the favorable action of Congress.

ALBERT MASON.
WILLARD P. PHILLIPS.
FRANCIS A. NYE.

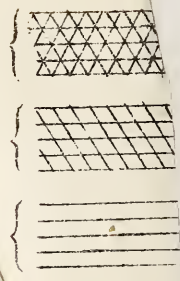
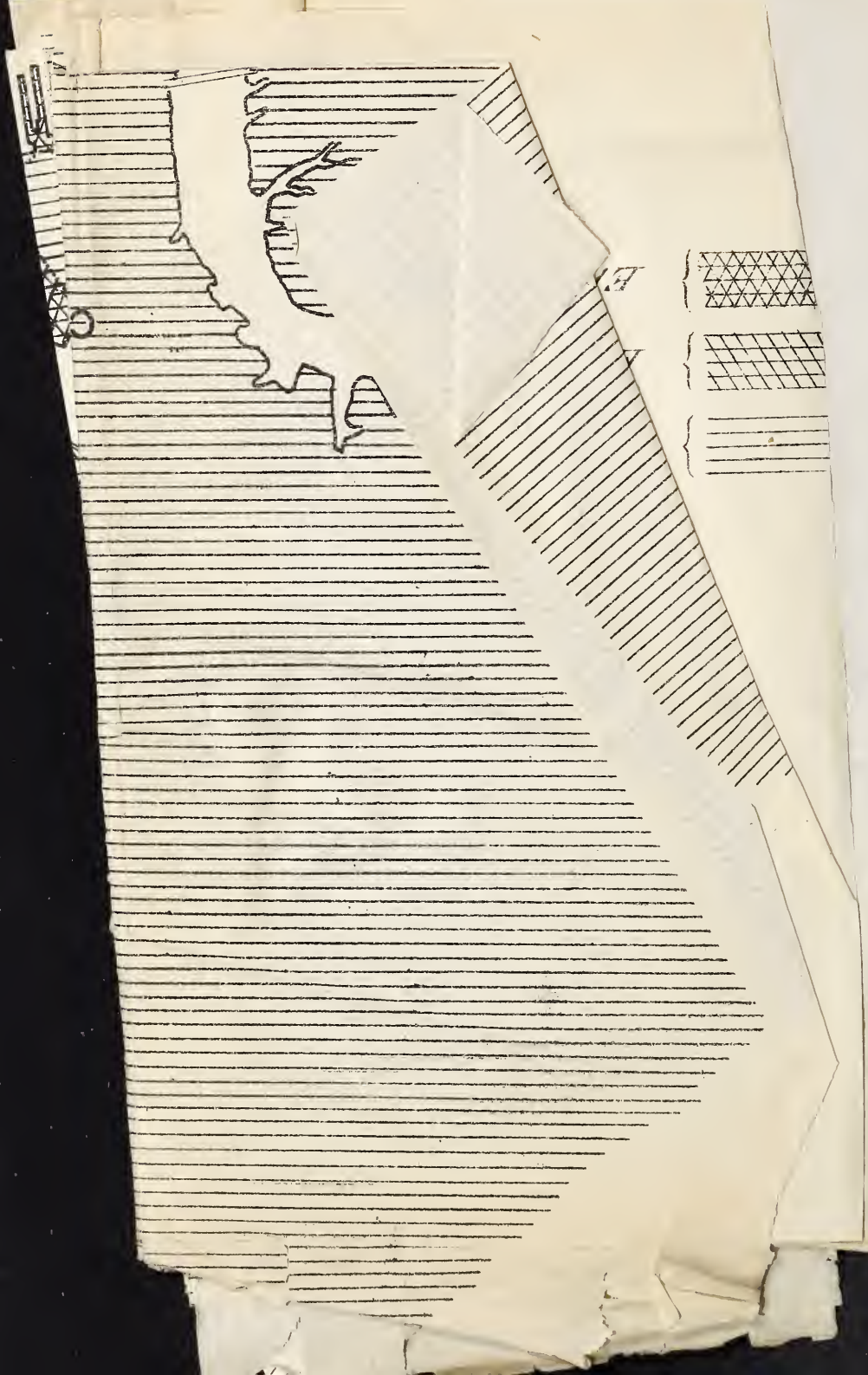
PLAN
 SHOWING ENCROACHMENTS UPON THE
 INNER BASINS OF BOSTON HARBOR
 ACCOMPANYING
 ANNUAL REPORT OF HARBOR AND LAND COMMISSIONERS
 1830.



Legend.

- Land within original shore lines.
- Encroachments possible within existing harbor lines.
- Encroachments actually made.

Scale : 1200 Ft. = 1 Inch.
 1000 500 100 500 1000 1500 2000 2500 Ft.
 PRINTED BY J. B. BOSTON.



APPENDIX.

APPENDIX.

[A.]

PHYSICAL CONSEQUENCES OF ENCROACHMENT UPON CHARLES RIVER BASIN.

IN discussing the subject, as above defined, it can be more systematically treated by considering the two geographical sections separately : namely, the water-space between Brookline and West Boston Bridges, which will be called, for the purpose of distinction, the Upper Basin ; and the water-space between West Boston and Cragie Bridge, which will be called the Lower Basin.

The natural and physical conditions of these basins are also of distinctive character.

The Upper Basin is a shallow water, with large areas of flats, dry at low tide, occupying much of its space, and through which a comparatively narrow channel of unequal depth and width forces its way.

The Lower Basin is of smaller area, with its channel portion comparatively larger, deeper, and more regular in form. The more contracted natural water-way between the firmer shores of the north end of the city proper and East Cambridge have formed a deeper channel, which continues this general character through the lower sections of the river to its confluence with Chelsea Creek and the Mystic ; and in its original natural state was one of the deepest, if not the very deepest, section of the arms of the inner harbor, and still so remains.

The value of these interior basins, as reservoirs, has been much affected by the obstructions which, from time to time, have been allowed to encumber the outlet of the river ; and the treatment of them, as factors in the conservation of the main harbor, made difficult and uncertain.

In the Ninth Report of the United States Advisory Council for Boston Harbor, pp. 11, 12, they say, " In the case of Charles River and its adjacent basins, the bridges offer at present too much obstruction to make a full reduction of flats and marshes serviceable. When the bridges which now encumber the mouth of Charles River and distort its bed are improved by the introduction of such systematic and uniform constructions as will increase the water-ways, and correct the present disorderly flow of the stream, it will be practicable to enlarge the tidal prisms here

described (of the basins above). In the existing state of things, we do not advise any excavations below the half-tide plane."

Much as it may be desired to improve constructions, and more particularly to remove obstructions, no precedent in the history of our legislation applicable to such cases can be found of acts effecting restoration of water-ways and water-spaces, or the removal of encroachments upon them, although frequently done elsewhere. It seems, therefore, only practicable to consider conditions as they are, and to deal with difficulties as they exist, and to so study and prescribe the better modes of change and adaptation to what may be the necessary demands of commerce and requirements consequent upon the steadily increasing proportions and importance of the port and city.

In the scheme of revised harbor-lines for the basins of Charles River, which was recommended by the Board, a careful study was made of the adjustments of filling and excavation, and a system of lines devised which left the tidal prism of these basins intact. The details of this plan were stated in the Seventh Annual Report of the Harbor Commissioners for 1873.

Upon the petition of riparian proprietors on the Cambridge side of the Upper Basin, the lines established in 1873 were changed by subsequent legislation (Chap. 77 of 1878), and a harbor-line established on the Cambridge side of the basin, which lessened its reserved water-area by about sixty acres, and its tidal prism by about 885,304 cubic yards. A statement of particulars in regard to the changes which were subsequently effected was made in the Annual Report of the Harbor Commissioners for 1877.

On Aug. 30, 1872, licenses were granted under Chap. 236 of the Acts of 1872 to George Griggs and others, Edward Atkinson and others, and to the Boston and Roxbury Mill Corporation, to build a sea-wall and fill solid behind the same on the southerly side of the Upper Basin out to the harbor-line. A detailed statement concerning this matter was given in the Seventh Annual Report of the Harbor Commissioners (1873). Work has been done in substantially carrying out the plans proposed, although it is not yet completed.

In the Lower Basin no change has been made in the harbor-lines as they existed at the time of the studies by the United States Advisory Council.

On July 8, 1874, the Board granted a license to James A. Woodbury and others, whose interests were afterwards merged in the Cambridge Improvement Company, to fill flats on the Cambridge side of the Lower Basin within the harbor-line. This contemplated the occupation of a large area, about fifty-five acres, and the displacement of about 802,080 cubic yards of tidal prism. The arguments and conditions of the license granted were stated in the Ninth Annual Report of the Harbor Commissioners for 1875. The operations of this company have been suspended, although something has been done in partially carrying out the original plans of filling and excavation; but, as the work is in an unfinished state, no surveys have been made by which its present condition can be ascertained with precision.

In the changes made in the basins of Miller's River and Prison Point Bay, the loss of reservoir capacity, or tidal prism, is much in excess of any compensating excavation; in fact, but little dredging has been done excepting some minor work in what remains of Miller's River. Compensation in money has been paid for a part of the tide-water displaced, but at a merely nominal price; the total amount received by the Commonwealth for the loss of these reservoirs being \$11,620 (?). If their full value had been paid, as estimated by the Advisory Council at the cost of compensation in kind, the amount would have been \$520,000.

A statement was made, in full detail, of the history of the disposition of those basins, in the Annual Report of the Board for 1877, from which the following extract is made: —

“Of the original bay, which comprised 64.8 acres, subject to the fourth section of the law of 1866 establishing the Board of Harbor Commissioners, 12.8 acres have been filled; there now remain unfilled 52 acres. Of the 12.8 acres filled, 7.3 acres have been reclaimed without authority; and of the 52 acres still unfilled, 29 acres have been licensed subject to compensation for tide-water displaced; so that there remain only 23 acres of tide-water, over which the Commonwealth retains any jurisdiction in the interest of harbor preservation.”

The following is a tabular statement of the data which have formed the subject of the preceding remarks: —

DESIGNATION.	ACT OF LEGISLATURE.		LICENSE OF BOARD.		AREA.		Depth of Tide.	Volume to be Displaced.	AREA ACTUALLY FILLED.		Volume actually Displaced.	Volume for which Compensation has been received.
	Chapter.	Year.	No.	Year.	Square ft.	Acres.			Square ft.	Acres.		
Eastern and Fitchburg Railroads, jointly	335	1867	21	1868	632,400	14.5	8.6	201,764	26,750	0.6	8,520	None.
City of Charlestown	253	1868	None.	None.	82,200	1.9	4.0	12,107	82,200	1.9	12,107	12,107
Encroachment by private parties inside Canal Street	None.	None.	None.	None.	-	-	3.9	-	159,709	3.7	23,069	None.
Encroachment by private parties outside Canal Street	None.	None.	None.	None.	-	-	6.8	-	66,500	1.5	16,746	None.
Encroachment by Commonwealth in vicinity of State Prison . .	None.	None.	None.	None.	-	-	4.0	-	79,107	1.8	11,720	None.
Boston and Maine Railroad . .	None.	None.	None.	None.	-	-	7.0	-	13,500	0.3	3,500	None.
Eastern Railroad	{ 360 45 }	{ 1873 1874 }	{ 207 391 }	{ 1874 1877 }	{ 787,565 - }	{ 18.1 - }	{ 8.1 - }	{ 236,269 - }	{ 129,636 - }	{ - 3.0 }	{ 38,891 - }	{ - None.

NOTE. — The above table represents the measure of quantities as they were at the time it was compiled, — January, 1878.

From as close a measurement and estimation as our data afford, some of which is not precise, the loss of reservoir capacity, or tidal prism, in the two basins of Prison Point Bay and Miller's River, amounts to about 1,384,600 cubic yards.

As the judgment and estimates of the Advisory Council were based upon the combined active functions of all the inner basins of Charles River, the loss of so much of those of Prison Point Bay and Miller's River makes it still more important to retain all the tidal power they yet possess in the remaining basins.

In the report of the Advisory Council, before referred to, the tidal prism of the inner basins of Charles River are given as follows: —

	CUBIC YARDS.
Between Brookline and West Boston Bridges . . .	9,259,900
Between West Boston and Cragie Bridges . . .	2,082,500
Prison Point Bay and Miller's River . . .	1,846,215
	<hr/> 13,188,615

The loss of tidal prism in these basins since the report of the Advisory Council including the contemplated displacement of tide-water by the harbor-lines of 1878 in the Upper Basin, and the fillings authorized on the part of the Cambridge Improvement Company in the Lower Basin, we have the following result: —

	CUBIC YARDS.
In the Upper Basin	885,304
In the Lower Basin	802,080
In Miller's River and Prison Point Bay	1,384,600
	<hr/> 3,071,984

About 22 per centum of the original tidal prism.

In comparing the amount of obstruction to the outlet of these basins in 1861, with that of the present date, — 1880, — those structures only are mentioned in which substantial change has been made.

In the report of the Advisory Council the areas of the bridges crossing the mouth of Charles River are given as follows, to which is added the areas of the same bridges at the present time in a separate column: —

	1861.	1880.
	Square feet	Square feet.
Warren and Fitchburg	272,900	389,890
Boston and Maine Railroad	216,750	284,390
Lowell and Eastern Railroad	128,740	249,770
Lowell Freight	83,300	112,900
Cragie	74,500	81,110
	<hr/> 776,190	<hr/> 1,117,060

About 50 per centum of *increase* from original area.

In an able report prepared by Gen. J. G. Foster in the spring of 1869, at th time the subject of widening and improving the draw-way openings

through the bridges crossing Charles River was under consideration, and while he was in charge of the government improvements being made in the lower harbor, he prepared a table of statistics, showing the extent and amount of obstruction to the free flow of the tide caused by those bridge structures, and from which the following items have been taken. Gen. Foster sent his own men, in boats, under the bridges, and had the piles in each bridge actually counted, and sketches made showing the irregular and injurious manner in which the piles were placed in the various structures.

	Number of Piles in each Bridge.	Mean height of Piles f'm bottom to high water.	Mean ob- struction offered by Piles.	Total water- space remain- ing after deducting the obstruction of Piles.
		Feet.	Square feet.	Square feet.
Charles River Bridge . . .	486	27	1,200	25,401
Warren Bridge	771	26	1,637	26,953
Fitchburg R.R. Bridge . . .	3,265	26	68,565	18,215
Boston and Maine R.R. Bridge .	3,754	24	72,077	17,477
Eastern R R. Bridge	1,022	24½	20,031	
Lowell R R. Bridge	672	24½	13,171	
Lowell Freight Bridge	756	24	14,515	34,435
Cragie Bridge	663	23	12,199	24,151
Total	11,389		203,395	

In the case of the Fitchburg Railroad bridge, the most objectionable structure, the striking condition is exhibited of a mass of obstruction amounting to 72,077 square feet with 17,477 square feet of free water-space; the obstruction being about four hundred per centum of the room left for free flowage.

As will be seen by looking at the maps, the bridges forming the most obstruction are in such close proximity and so grouped together as to form almost a continuous resistance to the flowage. These are the Warren and Fitchburg, in part one structure, the Boston and Maine, and the Eastern and Lowell passenger, also nearly a united structure. So that it may be said, that substantially these bridge structures, in 1869, contained 9,484 piles, each pile averaging a length of 25 feet within the water, and presenting the startling amount of 175,481 square feet of submerged surface; so disposed, both in rows and singly, that almost every pile presented an abrupt obstruction to the current. Allowing for the same ratio of increase in the piling as in the surface area of the bridges, there would be, at the present time, about 16,400 piles, and about 303,400 square feet of surface obstruction.

Although the piles which have been driven under the direction of the Board have been in lines which coincide with the direction of the current, so that when all the piles under all the bridges shall have been made to conform to the same order, the flowage will be improved, the disorderly manner in which the old piling still remains so shuts up the bays that no material gain is yet effected.

From the above statements it is evident that no improvement or relief to the outlet of the inner basins of Charles River has been effected since the criticism of their usefulness as tidal reservoirs was made by the able engineers who gave so much study and investigation to this subject.

It shows, however, the serious consequences and great misfortune of giving away, little by little, to encroachments, which, at the time, are made to appear insignificant in their physical disadvantage, while all important to other purposes they are proposed to serve, until, by persistent appeals for legislation, grants are obtained for which no commensurate equivalent is, or can be, given.

Already one of the choice portions of the inner harbor of Boston is lost to maritime commerce by the net-work of bridges that cross its deepest water ; unless it be not too late to reconstruct with a more wise adjustment of terminal facilities, of which Boston, as one of the few great ports of our Atlantic coast, stands so much in need. No part of the inner harbor affords more inducement to improvement than the lower portion of Charles River, from the Navy Yard to Cragie Bridge. The Advisory Council calls attention to it on physical grounds, and a comprehensive study of its capabilities will develop many other reasons for improvement.

Independent of physical considerations, the improved appliances of machinery and modes of dredging give the question of excavation a significance different from that of the earlier periods when it was less effectively and systematically managed, and when the inner reservoirs and outer channels of the harbor had more unobstructed avenues, by which to maintain their connections and exercise their mutual functions.

The subject of harbor conservation and improvement presents, to-day, more complicated features, and those which bring to bear upon it the results of experience and knowledge in the more modern modes of treatment.

In the licenses granted by the Board for the works in the upper basins of Charles River, the question of improved navigation was considered of so much importance, that it entered largely into the scheme of compensation. To further improve these basins by dredging them to a greater uniform depth, say ten or twelve feet at mean low water, would be a work of great value.

Such deepening, with the filling of all border-lands, would also be a sanitary work of the first order. It has been found, by experiment, in France, that the sanitary influence of waters which covered lands or marshes otherwise unhealthy, or into which sewage or other foul matter found its way, was in proportion to its depth ; that a film of water, although constantly maintained, did not prevent miasmatic exhalations, whereas *deep water* absorbed the noxious vapors, or was so far effective that the shores and grounds bordering upon them were rarely unhealthy.

The æsthetic question, in the treatment of these basins, is hardly less important, and has received a public and individual attention which entitles it to high consideration ; while nothing that is likely to be done in this direction will injure the navigable value of the basins, or impair their sanitary influence.

The purpose and occasion of the present study and investigation of this subject is a demand for land upon the borders of the Charles River basins which it is proposed to obtain by encroachments upon their water-spaces; and the discussion of facts and theories in regard to them has been made in the hope of leading the way to some wise solution of the problem under consideration.

In the plans proposed by the Park Commissioners and other parties, various lines have been suggested. Three definite ones, however, have been named by the Board for special consideration, — two in the Upper Basin and one in the Lower Basin.

The first in order is a line in the Upper Basin, beginning at some point in the present harbor-line near the westerly end of the Mill-Dam, and running easterly parallel to and 200 feet advanced from the Mill-Dam, turning the south-easterly corner of the basin by a suitable curve, and running northerly parallel to the easterly line of the basin, and terminating at a point on the West Boston Bridge, 200 feet westerly from the present sea-wall.

Such a general line will take from the basin area about . . . 1,602,400 sq. ft.
Equal to about 36½ acres.
And will reduce the tidal prism 930,100 cu. yds.
The amount of filling required to raise this area to grade
ten 978,279 cu. yds.

The second line in order is one following the same general course, and terminating at the same point on the West Boston Bridge, but being advanced substantially 300 feet into the basin.

Such a general line will take from the basin area about . . . 2,313,500 sq. ft.
Equal to about 53½ acres.
And will reduce the tidal prism 1,277,920 cu. yds.
The amount of filling required to raise this area to grade
ten 1,326,147 cu. yds.

The encroachment upon the Lower Basin by following the line proposed by the Park Commissioners, which runs from a point near the easterly abutment of Cragie Bridge in a generally straight course to the same point named in West Boston Bridge, 200 feet from the sea-wall, is about . . . 200,800 sq. ft.
Equal to about 4½ acres.
And will reduce the tidal prism about 74,370 cu. yds.
The amount of filling required to raise this area to grade
ten, about 109,990 cu. yds.

A further project has been brought forward to improve the opposite Cambridge shores of the Upper Basin ; and a belt of 200 feet, to be taken from the basin beyond the harbor-line, is asked for as a part of the proposed plan.

Such a line, 200 feet beyond the harbor-line, will take from
the basin area about 1,650,400 sq. ft.
Equal to about 37⅞ acres.
And will reduce the tidal prism about 550,865 cu. yds.
The amount of filling required to raise this area to grade ten
will be about the same 550,865 cu. yds.

A project looking to the improvement of the Cambridge shores, in connection with the improvement proposed upon the Boston side, is much to be desired; but there seems to be no adequate necessity for making land from the basin area on the Cambridge side, and no exigency to warrant an additional encroachment upon it from this direction to that which has been already made by the advanced harbor-line of 1878. The lands adjoining are in an unimproved and undeveloped state, open to other schemes of treatment. Upon the Boston side, where heavy sea-walls and expensive structures already occupy the immediate shores of the basin, it is more difficult to operate without taking some territory from the basin.

It would seem a more wise and practicable project to appropriate the marginal ground of the entire basin to park purposes, and to treat the subject of the improvement of this splendid basin as a unit.

To devote a certain margin to the æsthetic and healthful purposes of a park, and at the same time secure the establishment of *permanent boundary lines*, would have much to recommend it; but no concession should be made for private purposes, and the least amount of encroachment only allowed which will serve for public use.

That some reduction of the tidal prism of these basins may be permitted in consequence of the increased obstruction to their outflow, is possible; but to what extent can only be determined definitely after special examination and field observations similar in character to those which were the bases of the judgment of the Advisory Council. Such observations it has not been practicable to make since the questions under consideration have been presented. Without such data it would be unwise to prescribe changes in the physical status of the tidal forces, even as an offset to increased obstructions, large as they appear to be, which may produce results that cannot be predicted. As stated in a former report concerning the changes in the harbor-line of 1878, any scheme other than one looking to tidal compensation must be considered as arbitrary.

The Advisory Council did not recommend excavation in the upper basins of Charles River below the half-tide plane; but as there are only small portions of these basins near the upland line of the Cambridge shore, where the surface of the flats came above this plane, this rather negative caution on the part of the council goes to establish the theory that any material change in their present status is undesirable.

Assuming that two hundred feet of advance on the Boston side of the upper basin, and the line proposed by the Park Commissioners in the Lower Basin, will accomplish all that may be desirable, the remaining condition of these basins will be about as follows: —

Area of basins about	17,334,500 sq. ft.
Equal to about	398 acres.
Loss of tidal prism about	6,420,196 cu. yds.
Amount of excavation to deepen the basins to 12 feet below mean low water	5,825,350 cu. yds.
Amount of space inside of the stated lines as territory to be filled by the material removed from the bed of the basin up to say grade ten, is about	1,411,350 cu. yds.

While it is the logical inference that it is *not* desirable to *increase* the

reservoir capacity of the Charles River basins, it does not follow that it is desirable, or even permissible, to *reduce* them.

The basins, treated independently of the consequences to the harbor elsewhere, should remain as large in area as consistent with securing the desired depth. Their full utilization for navigation, also sanitary and æsthetic considerations, all require that the depth of water should be increased. To the extent necessary to secure a desired uniform depth in the area which may remain, a contraction of area may be permitted. This is not necessarily to permit just that area to be filled which will contain the material which it is requisite to remove, but rather that the privilege of filling which will constitute sufficient inducement to perform the necessary excavation.

The improvement of these basins ought not to be at the cost of the Commonwealth; but, on the other hand, if they can be so improved that great public benefits are conferred in their better adaptation to business and pleasure navigation, and in their sanitary and æsthetic effect on the community in which they are located, it is not essential that pecuniary profit should be derived by the Commonwealth from the improvement. If, when the public concedes some considerations of advantage, it secures other public considerations of greater moment, the gain is in even safer form than if committed into a money profit less permanent in its effects.

Great importance should be attached to the devotion of as much of the area as shall be reclaimed from the Charles River basins to *public purposes* as is practicable; not, of course, because of the effects upon the harbor below, but upon the broader grounds which any intelligent study of the question necessarily introduces. The harbor-line upon the Cambridge side, as already established, is a large concession to the owners of flats, and any further extension should be granted with great caution. The appropriation of a belt two hundred feet wide on that side to public purposes is very desirable; and, if it cannot be obtained within the present harbor-line, it may be expedient to make some further concession. But, if this should be done, it would be more difficult to permit the three hundred feet, or even the two hundred feet, extension upon the Boston side.

Respectfully submitted.

HENRY L. WHITING.

To the Board of Harbor and Land Commissioners.

[B.]

RE-SURVEY OF BOSTON UPPER HARBOR.

From West Boston Bridge eastward along the City, Front of Cambridge and Charlestown District, to U. S. Navy Yard.

STATIONS.	Latitude.	Longitude.	Azimuth.	To Station	Back Azimuth.	Distance.	Log. Meters.	Log. Feet.	Distance.
	Deg. Min. Sec.	Deg. Min. Sec.	Deg. Min. Sec.		Deg. Min. Sec.	Meters.			Feet.
A of Harbor-Line,	42 21 41.175	71 04 24.568	324 32 09	B of Harbor-Line,	144 32 25	926.123	2.9666685	3.4826362	3,038.339
B "	42 22 05.624	71 04 01.084	239 22 09	C "	59 22 19	378.337	2.5778793	3.0938470	1,241.215
C "	42 22 11.872	71 03 46.856	282 25 27	D "	102 25 43	553.963	2.7434809	3.2394486	1,817.392
D "	42 22 08.009	71 03 23.210	258 56 54	E "	78 56 59	161.266	2.2075437	2.7235114	529.068
E "	42 22 09.011	71 03 16.292	239 07 01	F "	59 07 04	115.526	2.0626796	2.5786473	379.007
F "	43 22 10.933	71 03 11.958	235 48 08	G "	55 48 17	368.383	2.5662991	3.0822168	1,208.556
G "	42 22 17.644	71 02 58.639							

[C.]

CONTRACT WITH THOMAS POTTER.

Articles of Agreement made this twenty-eighth day of August, in the year eighteen hundred and eighty, by and between THOMAS POTTER, of Jersey City, in the State of New Jersey, party of the first part, and the COMMONWEALTH OF MASSACHUSETTS, acting by its Board of Harbor and Land Commissioners, party of the second part, witness:—

The said party of the first part hereby covenants and agrees with said party of the second part, to dredge three hundred thousand cubic yards of material from the shoals, in that part of Boston Harbor represented by the space colored red on the plan hereto annexed, at places to be designated by the engineer of the Board of Harbor and Land Commissioners, and to deposit said dredged material on the flats of said Commonwealth, lying east of and adjoining the flats bargained to the Boston and Albany Railroad Company, and between the southerly line of Eastern Avenue or Congress Street extended, and the northerly line of occupation as indicated on said plan, at such places and in such order as the engineer of said Board shall designate. It is agreed that all said dredging shall be to a depth of twenty-three feet at mean low water, and that the bottom of the whole area dredged over is to be left smooth and regular at that depth to the satisfaction of the engineer of said Board, and that the amount of excavation shall be determined by measurement of the filling when deposited as herein provided, the present surface as shown on a plan of even date herewith made in duplicate and entitled "Plan of Filling at South Boston Flats for the Commonwealth," and signed by said party of the first part, and by said Board, to be used as the basis of such measurement.

All said filling shall be made from the present surface to grade thirteen, and shall be left smooth and level at said grade thirteen, and where the boundaries of said filling are protected by other filling, or by wall or bulkhead, the filling shall be brought up to grade thirteen at such boundaries; but where the boundaries are unprotected the material may be allowed to take its natural slope. In filling immediately behind a wall or bulkhead the material shall be deposited in such a manner that it will flow away from the wall or bulkhead, and not towards it. The lines, grades, and instructions given by the engineer of said Board, shall be strictly observed, and all necessary aid and materials for giving said lines and grades shall be furnished by said party of the first part. The dredging and filling aforesaid shall be commenced within three months after the execution and delivery of this agreement, and shall be prosecuted

continuously during all suitable weather, and with as much despatch as reasonably practicable until its completion; and shall be completed on or before the first day of January, in the year eighteen hundred and eighty-three.

The said party of the second part hereby covenants and agrees with said party of the first part, to pay said party of the first part for said dredging and filling at the rate of thirty-six cents per cubic yard, in the manner, and upon the terms and conditions, herein set forth and agreed, as follows: —

Monthly estimates of the work executed will be made by the engineer of said Board, and for all the material deposited directly from the scows, a payment of seventy-five per cent of the contract-price will be made; and for all material deposited from cars, a payment of ninety per cent of the contract-price will be made; and when said filling is completed to grade seven upon any portion of said area to be filled, for the material deposited on the area so raised to grade seven such further payment shall be made as will make the entire payment therefor equal to ninety per cent of the contract-price; and upon the entire completion of all said dredging and filling, in the manner and within the time herein agreed, the remainder of said contract-price shall be paid.

It is agreed, by and between the parties hereto, that upon all questions of measurement, lines, or grades, the decision of the engineer of said Board shall be final.

It is further agreed, by and between said parties hereto, that should the party of the first part refuse or neglect to prosecute the work herein contracted for, with the requisite vigor to insure its completion within the time herein stipulated, or in any other respect violate this agreement, the said Board shall have power to annul this agreement, and to contract anew with other parties.

In testimony whereof, the said Thomas Potter has hereunto set his hand and seal, and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered, in its name and behalf, by its Board of Harbor and Land Commissioners, the day and year above written, and the same to be approved by its Governor and Council.

THOMAS POTTER. [SEAL.]
COMMONWEALTH OF MASSACHUSETTS,

[SEAL OF THE
COMMONWEALTH.]

By ALBERT MASON,
WILLD. P. PHILLIPS,
FRANCIS A. NYE,
Harbor and Land Commissioners.

IN COUNCIL, Aug. 31, 1880.

Approved.

HENRY B. PEIRCE, *Secretary.*

[D.]

BILL RECOMMENDED.

Commonwealth of Massachusetts.

AN ACT TO AUTHORIZE THE CONSTRUCTION OR EXTENSION OF
WHARVES IN BOSTON.

Be it enacted, &c., &c.

That the Harbor and Land Commissioners shall be, and hereby are, authorized to permit the construction or extension of wharves in that part of Boston called East Boston, easterly of Pier No. 4, so called, of the Boston and Albany Railroad Company, to such line as they shall prescribe, and in such manner, and on such terms and conditions in other respects, as are now allowed by law, or shall be prescribed by them.

[E.]

STATEMENT OF OPERATIONS DURING THE YEAR ENDING DEC. 31, 1880, ON WORKS FOR THE IMPROVEMENT OF RIVERS AND HARBORS IN THE STATE OF MASSACHUSETTS, UNDER THE CHARGE OF BREV. BRIG.-GEN. GEORGE THOM, COLONEL OF ENGINEERS.

I.—IMPROVEMENT OF BOSTON HARBOR, MASSACHUSETTS.

The following operations for the improvement of this harbor by the United States Government have been carried on during the year ending Dec. 31, 1880, to wit:—

1. Under a contract made Aug. 15, 1878, with Mr. Joseph E. Bartlett of Boston, Mass., for the removal, by dredging, of the Man-of-War Shoal (situated in the upper harbor, at the confluence of Charles and Mystic Rivers), to a depth of 23 feet at mean low water, dredging operations, commenced by him in the latter part of 1878, were continued until the 12th of March, 1880, resulting in an aggregate of about 86,000 cubic yards, in completion of said contract; of which dredging about 6,000 cubic yards was done subsequent to the 1st of January. By these operations this shoal has been reduced on an area of about 55,000 square yards to the projected depth of 23 feet at mean low water, on the shoalest part of which the depth was formerly but $15\frac{1}{4}$ feet. This work was done in a very satisfactory manner, and under difficulties, for which the contractor is entitled to much credit.

2. On the 28th of August, 1879, a contract was made with the New England Dredging Company, of Boston, Mass., for—

(a) 38,000 cubic yards, more or less, of dredging at Anchorage Shoal, for obtaining a depth of 23 feet at mean low water, at 74 cents per cubic yard, *measured in situ*; and

(b) 6,000 cubic yards, more or less, of dredging at the Lower Middle Shoal, to the same depth as above, at 84 cents per cubic yard, *measured in situ*.

Operations were commenced under this contract at Anchorage Shoal on the 15th of September, 1879, and were continued up to the 17th of December, when they were suspended for the winter. They were resumed on the 19th of April, and, after some interruptions by the dredging at the Lower Middle, were completed on the 22d of September, 1880, resulting in an aggregate of 27,556 cubic yards of dredging (*in situ*) under and in completion of said contract; of which 17,619 cubic yards has been done during the past year. By these operations the main ship-channel has been opened on an area of about 48,600 square yards, to a depth of 23 feet at mean low water, for a width of about 550 feet.

At the Lower Middle Shoal dredging was commenced, under this contract, on the 14th of June, and continued until the 15th of August, 1880, during which period 5,007 cubic yards of dredging (*in situ*) was done, on an area of about 17,500 square yards, in completion of said contract. By these operations the main ship-channel has been widened and deepened so as to have, for a width of 600 feet, a depth of 23 feet at mean low water.

3. On the 11th of September, 1879, a contract was made with the New England Dredging Company—the lowest of four bidders, after proposals had been twice invited for the work—for 50,000 cubic yards, more or less, of dredging in Mystic River, near its mouth, at 33 cents per cubic yard, *as measured in scows*. Operations were commenced under this contract on the 2d of October, 1879, and continued up to the 15th of March, 1880, resulting in an aggregate of 47,953 cubic yards of dredging on an area of about 25,000 square yards, in completion of the contract, of which 21,830 cubic yards of dredging has been done during the present year. By these operations the main channel at this place has been opened to a depth of 23 feet at mean low water (or 33 feet at mean high water) for a width of 125 feet throughout the whole extent of this shoal. The adopted project calls for a width of 300 feet when completed.

4. A large and dangerous sunken rock, recently discovered and located in the main channel in Broad Sound, was broken up and removed in August and September last. This rock had a depth of but 9 feet of water on it at mean low water, with a depth of 16 feet around it. After several attempts to find it, it was discovered by the aid of a diver who had been employed on a vessel which had run upon it in April last.

By the operations of the past year, as above described, all the work hitherto projected for the improvement of Boston Harbor proper has been completed, with the exception of that at Anchorage Shoal, where it is projected to open the main ship-channel to a least width of 1,000 feet.

By the River and Harbor Act of June 14, 1880, the sum of \$75,000 was appropriated for the improvement of Boston Harbor to be applied as follows, viz.:—

1. Boston Harbor proper	\$30,000
2. At the mouth of Charles River, in said harbor, and up to Watertown	22,500
3. At the mouth of Mystic River, in said harbor	17,500
4. From said harbor to Nantasket Beach	5,000

Under this appropriation the following work has been done for improving navigation at the several places named, viz.:—

1. *Boston Harbor proper*.—A contract has been made with Messrs. Moore & Wright of Portland, Me.,—the lowest of five bidders,—for 65,000 cubic yards, more or less, of dredging at Anchorage Shoal, at 39 cents per cubic yard, *measured in scows*, the same to be completed on or before the 30th of June, 1881. Preparations are being made to commence this work on or about the 1st of January. It is probable that under this contract this channel will be opened for an additional width of about 325 feet, and a total of 875 feet.

2. *At the mouth of Charles River, in said harbor, and up to Watertown.* — A survey of Charles River was made in 1878 with a view to its improvement from its mouth up to the head of tide-water at Watertown. The project for its improvement consists of opening the channel *first*, from its mouth up to Western-avenue Bridge (a distance of about $4\frac{3}{4}$ miles) to a depth of not less than 7 feet at mean low water (or about 17 feet at mean high water) for a width of 200 feet; *second*, from Western-avenue Bridge up to Market-street Bridge (an additional distance of about $3\frac{1}{4}$ miles) to a depth of not less than 6 feet at mean low water (or about 16 feet at mean high water) for a width of 100 feet; and *third*, from Market-street Bridge up to the dam at the head of tide-water (an additional distance of about $1\frac{3}{4}$ miles) to a depth of 3 feet at mean low water for a width of 75 feet. The estimated cost of this improvement, at the prices now ruling, is \$125,000. In commencement of this work under the appropriation made therefor, as above (to wit, \$22,500), a contract has been made with Messrs. Moore & Wright of Portland, Me., — the lowest of four bidders, — for 50,000 cubic yards, more or less, of dredging, at 39 cents per cubic yard, *as measured in scows*, the same to be completed on or before the 30th of June, 1881. Operations were commenced under this contract in the latter part of November, and have been continued to this date. It is expected that, with the amount now available for this river, its improvement will be completed, as projected, up as far as Western-avenue Bridge.

3. *Mouth of Mystic River.* — Under the appropriation of \$17,500 made by act of June 14, 1880, for improving the channel at this place, a contract has been made with Messrs. Moore & Wright of Portland, Me., — the lowest of five bidders, — for 50,000 cubic yards, more or less, of dredging, at 29 cents per cubic yard, *as measured in scows*, the same to be completed on or before the 30th of June, 1881. Operations were commenced under this contract in November last, and have been continued to this date. It is expected that, with the amount now available for this work, the channel will be opened to the projected depth of 23 feet at mean low water for an additional width of about 120 feet, — making a total width of about 245 feet, the full projected width being 300 feet.

4. *Nantasket Beach Channel.* — In order to ascertain the nature and extent of the improvements contemplated for this place, a survey has recently been made of this channel from its head at Nantasket Beach down to its outlet at World's End; and the project adopted for its improvement consists in straightening, widening, and deepening the channel by dredging, and by the removal of sunken ledges from the mouth of Weir River up to the steamboat-wharf (a distance of about 600 yards), so as to have a depth of 9 feet at mean low water (or about 19 feet at mean high water) for a width of 100 feet. A contract for the dredging (viz., 15,000 cubic yards, more or less) has been made with Mr. Robert Hamilton, jun., of Chebeague Island, Me., — the lowest of three bidders — at $18\frac{3}{4}$ cents per cubic yard, *as measured in scows*, the same to be completed on or before the 15th of May, 1881. In addition to the dredging, about 12 cubic yards of sunken ledge will also have to be removed. The unexpended balance now available will be sufficient for completing this work.

The estimated cost (additional) for completing all the improvements projected for the harbor and rivers, as above, is as follows : —

1. Anchorage Shoal	\$37,500
2. Mystic River Shoal	10,000
3. Charles River	102,500
<hr/>	
Total	\$150,000

For these works the sum of \$125,000 has been asked to be appropriated by Congress for the next fiscal year.

II. IMPROVEMENT OF MERRIMAC RIVER, INCLUDING NEWBURYFORT HARBOR, MASSACHUSETTS.

The present project for the improvement of this river was adopted in 1870, and modified in 1874 ; the object being to afford a channel of navigable width, and a depth of not less than 9 feet at mean low water (or about $16\frac{3}{4}$ feet at mean high water) from its mouth at the outlet of Newburyport Harbor up to Deer Island Bridge, a distance of about five miles ; and thence up to Haverhill Bridge (an additional distance of $12\frac{1}{2}$ miles), a depth of 12 feet at ordinary *high* water, the rise and fall of tides varying from $7\frac{1}{2}$ to 4 feet ; and thence up to the head of the “ Upper Falls ” (an additional distance of 4 miles), a depth of not less than $4\frac{1}{2}$ feet in the ordinary stages of the river with the mill-water at Lawrence running ; the rise and fall of the tide varying from 4 feet at Haverhill to 0 at the foot of the “ Upper Falls.”

The natural channel of this river was very narrow and crooked in several places, and much obstructed by sunken ledges, bowlders, and shoals ; and especially at “ the falls,” portions of which were covered with bowlders and ledges more or less bare, and impassable for any vessels or scows ; whilst in Newburyport Harbor the channel was obstructed by numerous sunken ledges, crib-work piers, and wrecks, seriously endangering navigation.

Previous to January, 1880, the work done for the improvement of this river consisted in opening the channel above Haverhill and through “ the falls ” to the projected width and depth, in places where absolutely necessary to make its navigation practicable ; also, in dredging at Haverhill, between the bridges, and at Silsby’s Island Shoals, as well as at Currier’s Shoal (about 4 miles below Haverhill), and at Rock’s Bridge ($6\frac{3}{4}$ miles below Haverhill), including the removal of a large number of dangerous sunken rocks at and near Rock’s Bridge and the head of Silsby’s Island ; also, in Newburyport Harbor, in the partial removal of Gangway Rock and North Rocks, and in the removal of a sunken wreck.

By the River and Harbor Act of June 14, 1880, the sum of \$12,000 was appropriated for continuing the improvement of Merrimac River, which, with \$3,092 available from the appropriation of March 3, 1879, made \$15,092 available for this work. This amount has since all been applied to the improvement of the river, as follows, viz. : —

1. *At and near its Mouth in Newburyport Harbor.* — Under a contract made with Mr. James Andrews of Biddeford, Me., — the only bidder, —

for *completing* the removal (commenced in 1870) of Gangway Rock, at \$30 per cubic yard, *measured in situ*, this work was completed by him between the 11th of September and the 8th of October, 1880, whereby the rock was broken up and removed to a depth of 9 feet below the plane of mean low water, or $16\frac{7}{10}$ feet at mean high water, requiring the removal of $22\frac{1}{2}$ cubic yards of ledge above that plane.

A submarine party, with a sloop provided with suitable steam-drills and hoisting apparatus, was also employed by the day in the removal of the following obstructions in Newburyport Harbor, to wit:—

First, Six sunken piers and one sunken scow lying directly across the main channel one-half a mile above its mouth at Salisbury Point. These piers had about 5 feet of water over them at mean low water, and were built of crib-work, and ballasted with stone; and, it is said, they were placed there in about 1812 and previous thereto in order to prevent the entrance of hostile vessels into the harbor. By means of the submarine parties, two of these piers and one scow were discovered during these operations. These piers and scow were all broken up, and removed to a depth of not less than 9 feet at mean low water.

Second, The wreck of the schooner “Greyhound,” sunk in November, 1879, was broken up, and removed from the main channel at the entrance of the harbor.

Third, A large sunken rock (ledge) lying in mid-channel between the north and south piers was broken up, and removed to a depth of 12 feet at mean low water, containing altogether about $6\frac{1}{2}$ cubic yards; and other shoal points of ledge situated in the main channel near North Rocks and the mouth of the river were in part broken up and removed. These submarine operations were carried on between the 28th of July and the 11th of September, and afterwards between the 9th and 31st of October, 1880.

2. *At and near “the Falls” above Haverhill, and at Rock’s Bridge, $6\frac{3}{4}$ Miles below Haverhill.* — Under a contract made with the Pentucket Navigation Company for the removal from the channel at the “Lower Falls” of $95\frac{1}{2}$ cubic yards of sunken ledge, at \$30 per cubic yard, *measured in situ*, this channel has been completed to its full projected width and depth. This work was commenced in September, 1879, and completed on the 25th of October, 1880.

For the further improvement of the channel at “the falls” and Rock’s Bridge, a dredging-machine and scows (specially adapted to this work), with full crews for the same, were hired by the day, at \$75 per working-day of ten hours. Dredging operations were commenced at the Upper Falls on the 30th of July, and continued to the foot of the Lower Falls till the 2d of November; during which period the channel at the Upper Falls was straightened, widened, and deepened where necessary for the completion of the same. The channel at the Lower Falls and below was also widened and straightened; and with the aid of a diving party, a very large quantity of ledge and bowlders was broken up, and removed from the channel throughout the whole extent of “the falls.” The unusually low stage of the river this season facilitated these operations to a degree seldom to be experienced, and for this reason they were continued until

a rise of water. On the 10th of November the dredging-machine and diving party were transferred to Rock's Bridge, where they were employed until the 20th of November in deepening the channel and in removing numerous large bowlders by which navigation had been much endangered at that place.

By the operations above described, the navigation of the river has been very much improved during the past season. But more work still remains to be done, especially in the removal of sunken rocks at Rock's Bridge and in Newburyport Harbor, for effecting all the improvements necessary.

An additional appropriation of \$16,500 has been asked for this work.

III. IMPROVEMENT OF NEWBURYPORT HARBOR, MASSACHUSETTS.

By the River and Harbor Act of June 14, 1880, the sum of \$50,000 was appropriated for the improvement of this harbor, which it has been decided to apply to the improvement of the shifting and uncertain channel at its entrance by means of rubble-stone jetties. With a view to a proper understanding of the bar and currents at its entrance, as well as of the material composing the bar, and all other facts bearing upon this subject, a very accurate survey was made of this locality in July and August last. A new project, based upon this survey, was submitted to the War Department in September last, which has since been approved and adopted. It consists of two converging rubble-stone jetties built out from the shores north and south of the entrance to such an extent as will secure a constant depth of $13\frac{1}{2}$ feet across the bar at mean low water, or 21 feet at mean high water. The estimated cost of these jetties, together with the shore protections at the extremities of Salisbury Beach and Plum Island, is \$240,000.

Under the appropriation made, as above, for this work, a contract has been made with Mr. Frederic A. Ingerson of Haverhill, Mass., — the lowest of four bidders, — for furnishing and placing in the northern jetty (beginning at its shore end) 50,000 tons, more or less, of rubble-stone in commencement of this improvement, the work to be commenced on or before the 1st of April next, and the contract to be completed on or before the 30th of November, 1881.

IV. IMPROVEMENT OF SCITUATE HARBOR, MASSACHUSETTS.

A survey of this harbor was made by Gen. Thom in 1878, "with a view to its adaptability as a harbor of refuge;" based upon which a project was made and submitted to the War Department, with estimates of cost for the same. This project consists of two rubble-stone jetties, or breakwaters, built at the entrance of the harbor: one to project from Cedar Point near the lighthouse on the north side of the entrance, in a direction south, 36° east, for a distance of 800 feet; and the other to project from the point of the first cliffs on the south side of the entrance, in a direction north, 10° west, for a distance of 730 feet, being so located as to shut out all easterly winds from the proposed harbor, and also to occupy the shoalest and most favorable sites in regard to cost.

In connection with the jetties, it is proposed to excavate a basin inside of sufficient area for the harbor, with a depth of 10 to 12 feet at mean

low water, or about 20 feet at mean high water; the greatest depth at present being not more than about 5 feet at mean low water on a very small area: also to excavate a channel, so as to afford an easy ingress into the harbor with a constant depth of not less than 10 feet at mean low water.

The estimated cost of this improvement, as revised for the project adopted, is \$225,000.

This project has been approved by the War Department, and the construction of the jetties will be commenced as soon as a sufficient appropriation shall be made by Congress to justify it. By the River and Harbor Act of June 14, 1880, the sum of \$7,500 was appropriated therefor.

V. IMPROVEMENT OF PLYMOUTH HARBOR, MASSACHUSETTS.

All the works projected for the protection and preservation of Long Beach (which gives to this harbor its only shelter from easterly storms) were completed in 1879; but, exposed as they are to injury from those violent storms, they will necessarily require occasional repairs. They are now in an essentially good condition, and fully answer the purpose for which they were designed.

For the improvement of the harbor itself, the sum of \$10,000 was appropriated by the River and Harbor Act of March 3, 1875, by which a channel about 50 feet in width was opened by dredging from the Middle Ground up to Long Wharf, — a distance of about 2,500 feet, — to a depth of 6 feet at mean low water, or 16 feet at mean high water.

The project for the improvement of this harbor provides for a channel 6 feet in depth at mean low water, and 100 feet in width, up to Long Wharf; and thence extended southward to the mouth of Town Brook, — a distance of about 900 feet above Long Wharf, — so as to form a basin in front of the wharves of the town 125 feet in width, with a depth of 8 feet at mean low water.

For continuing this improvement, the following sums have since been appropriated by Congress, to wit : —

By the River and Harbor Act of March 3, 1879	\$3,500
By the River and Harbor Act of June 14, 1880 :	10,000
Total	<u>\$13,500</u>

Owing to the smallness of the appropriation of 1879, it was decided to wait for an additional appropriation before doing any thing further towards the completion of this work.

With the above amount available (\$13,500), a contract has been made with Messrs. Robert Hamilton, jun., and Solomon Sawyer, of Maine, — the lowest of four bidders, — for 60,000 cubic yards, more or less, of dredging, at 17 cents per cubic yard, *measured in scows*; the same to be completed on or before the 30th of June, 1881. The contractors commenced dredging under their contract on the 11th of November, 1880, and have continued it up to the close of the year, whereby the channel has been opened to a width of about 70 feet, with the projected depth.

For completing this improvement to the extent projected as above, an

additional appropriation of \$11,500 has been asked for, to be expended in the next fiscal year.

VI. IMPROVEMENT OF PROVINCETOWN HARBOR, MASSACHUSETTS.

All the works projected for the protection, preservation, and improvement of this harbor, have been completed, with the exception of the bulkhead on Long Point. These works are all in good condition, and fully answer the purpose designed. They will, however, require continual watching and occasional repairs.

Under the appropriation of \$500 made by the River and Harbor Act of June 14, 1880, together with the unexpended balance of the appropriation of March 3, 1879, aggregating \$1,112.17, repairs have been made where most necessary, — on the bulkhead on Long Point, in which $664\frac{8.0.0}{2240}$ tons of rubble stone has been used.

For completing the stone bulkhead on Long Point, and making repairs on other works where necessary, an appropriation of \$7,000. has been asked for the next fiscal year.

VII. SURVEY OF MALDEN RIVER, MASSACHUSETTS.

By the River and Harbor Act of June 14, 1880, provision was made for the survey of this river, with a view to the improvement of its navigation. This survey has since been completed, and a project for its improvement, with an estimate of its cost (amounting to \$35,000), has been submitted to the War Department for the information of Congress.

This project consists of straightening, widening, and deepening its channel from its mouth up to the bridge near the rubber-works in Malden, — a distance of about two miles, — so that vessels drawing 10 feet of water can ascend to that bridge on the high water of neap tides in a channel 100 feet in width.

[F.]

STATEMENT OF OPERATIONS DURING THE YEAR 1880
ON WORKS FOR THE IMPROVEMENT OF RIVERS AND
HARBORS IN MASSACHUSETTS, UNDER THE CHARGE
OF BREV. MAJOR-GEN. G. K. WARREN, LIEUTENANT-
COLONEL OF UNITED STATES ENGINEERS.

[A.]

SURVEY OF NANTUCKET HARBOR, MASSACHUSETTS.

It must be noted that the wording of the act does not specify any particular place of improvement; whether to deepen the water on the bar at the existing entrance, which the United States undertook to do by dredging in 1829, '30, '31, or to attempt to make an opening through the Haulover Beach into the "upper harbor," a scheme that has several times been brought up for consideration, and notably so in the reports accompanying the Annual Report of the Board of Harbor Commissioners of Massachusetts for the year 1872, and there recommended as "an experiment" "worth an earnest trial."

That the Nantucket Bar has always been an obstruction, and of a most serious character too, is unquestionable. The survey made by Lieut. Jonathan Prescott, First United States Artillery, reported Jan. 13, 1829 (printed, House Representatives, War Department, Document 97, 2d session Twentieth Congress), gives the depth on the shoalest bar as "6 feet at low water." Lieut. Prescott does not state what low water is meant, whether mean or extreme; but it is probable that mean low water is intended.

The United States Coast Survey charts of the survey of 1846 show 6 feet at mean low water. Further soundings by the United States Coast Survey in 1865 show still 6 feet as the limiting depth. The survey made by me in 1874 shows about the depth of 6 feet at mean low water; and our examinations this year show a depth of 6 feet at mean low water. (The mean rise of the tide is about 3 feet. Spring tides range about 4 feet, so that low water of spring tides would not give more than $5\frac{1}{2}$ feet on the bar, and the extreme low waters of very rare occasions may not allow more than 4 feet.)

It does not appear, then, as a fact that the bar has, during the past few years, become a greater obstruction by a lessened depth thereon; but the line of deepest water is frequently shifting. This is supposed by some to be due to changes produced by the ice lodging upon the bar in winter, and the changing appears to have been principally on the outer shoals, and always in a direction to the eastward.

It is a fact that the mail-steamer experienced unusual delays in the early part of the present year, but this was owing to the new channels which had formed not being found. Capt. Gibbs, of the lighthouse steamer "Verbena," however, sounded and buoyed the new channel-line, which, as our recent survey shows, has the normal depth of 6 feet at mean low water as its limiting shoal, just as it has been heretofore. I believe it is conceded now, even by those who draughted the memorial, that the depth on the bar is as great as it has ever been.

While on the matter of obstruction to entering Nantucket Harbor, it may as well be stated that the ice in winter does not generally prevent the mail-steamer going out and in. Some winters she loses one, two, or three days. In the experience of forty-eight years — the first steamer was put on in 1831 — there were not more than five winters when fifteen days were lost. In the winter of 1856, '57, thirty to forty days were lost.

There is here a large miscalculation as to the size of this head of the harbor, which includes only the part between Pocomo Head and the Haulover Beach, this part being separated from the rest of the harbor by a shoal not having more than 1 to 2 feet depth on it at low water.

According to the United States Coast Survey charts, the whole area of the upper harbor between Pocomo Head and the Haulover at low water is 1,920 acres, or 3 square miles; the area having 6 feet at mean low water, 960 acres, or $1\frac{1}{2}$ square miles; the area having 12 feet at mean low water, 280 acres, or $\frac{2}{3}$ square mile; the area having 18 feet at mean low water, 128 acres, or $\frac{1}{3}$ square mile.

Practicability of making a Permanent Opening through the Haulover Beach 9 or 10 Feet Deep at Mean Low Water.

After a full discussion of this project Gen. Warren expresses the following opinion: "It appears to me that from the foregoing showing there is very little reason to believe the experiment will ever succeed. It is with great regret, as far as it disappoints honest expectations, that I am compelled by my honest judgment to say so."

The Project of Improving the Present Entrance to Nantucket Harbor.

A consultation of ordinary maps, and particularly the charts of the United States Coast Survey, presents so good an idea of the general features of this harbor and island, that a description is not necessary.

It has been stated in the first part of this report, that there is and always has been, since the occupation of the island, a limiting navigable depth at the entrance of about 6 feet at mean low water. The shoal is of great breadth, with channel poorly defined, and is composed of sand, easily moved by waves and currents, so as to change from year to year. The outer part of the bar was found by Lieut. Prescott, in 1828, to be composed of sand for a thickness of 3 feet, and below that of hard blue clay. This determination has not since been repeated. If this clay underlies the sand for any considerable extent of the bar, it would indicate the base of the bar to be probably composed of glacial deposit similar to many parts of the island.

Nantucket Island, in recent times, does not seem to suffer much from the abrasion of the sea, its shores being nearly everywhere protected by a beach of sand. Observation shows that this sand probably comes from the waste of the south shores of Martha's Vineyard Island, particularly the high cliffs near its west south shore.

The motion of this sand along the shore of Martha's Vineyard Island is eastward. Falling into the Muskeget Channel (separating it from Nantucket) large portions are carried seaward, forming Wasque (Wasque) Shoal, and the remainder crosses this channel, and forms Tucker-nuck and other shoals to the west of Nantucket. It is probable that a portion of this sand, which is moved by the waves across the Muskeget Channel, keeps moving eastward, both on the north and south sides of Nantucket Island; thus contributing to the bar at the entrance to Nantucket Harbor, and to the beach on the south shore of Nantucket Island.

The form of the Coatue Beach, east of the entrance, indicates also a motion of the sand in the contrary direction, westward from Great Point; but this is probably only a wave-shore motion from the point towards the hollow of the great bend of the shore, while the eastward motion of the sand from Muskeget Channel is due to the combined power of the waves and currents, whose sands in part the waves throw upon that shore.

The position of Point Rip, off and east of Great Point (see Diagram A), indicates that the sand brought here is mainly deposited on the east side, so that the sand coming around from the south by the east side of the island does not come into Nantucket Sound.

If now we compare Nantucket Harbor with Edgartown, we see that there is no drifting sand from the west to the east across the north side of Martha's Vineyard, as in the case of Nantucket, and consequently no supply of sand to fill up Edgartown entrance, as in the other case. Edgartown entrance was, therefore, deeper than Nantucket entrance, from causes independent of the southern opening the former had through Cotamy Beach; and the closing of this latter has in no way injured Edgartown Harbor. Hence there is no reason to think that an opening through the Haulover will make Nantucket entrance like that at Edgartown, and the cases are so dissimilar that we cannot conclude that it may not be an injury at Nantucket if we make a permanent opening through the Haulover.

Assuming, then, as reasonable, that the sands at the Nantucket Bar come from the west through the Muskeget Channel, and are spread out over the sound, it is probable that the north winds and their waves drive this upon the hollow bend of the Nantucket shore, and that the littoral wave-motion works the sand both east and west towards the entrance, as there is a sand-spit on both sides, although that forming Coatue Beach on the east is much longer than that known as Brant Point on the west.

The sand-spits, thus maintained by littoral sands moving towards the ends, approach each other as closely as the water entering and leaving the tidal basin will allow; and then the sand which reaches the ends is washed away by the current, some going to fill up the harbor, and some going to form the bar outside.

The overlapping of the Coatue Point shows that the supply from this direction exceeds that from Brant Point, and this condition gives a direction to the issuing or ebb current towards the north-west. But at the outer part of the bar (nearly one mile distant) the currents of the sound are nearly always eastward, so that a new direction is given to the line of deepest water there, and the channel has for years past been moving eastward at its outer end.

Plan of Improvement of Nantucket Bar.

This bar (independent of what influence the underlying clay reported by Lieut. Prescott has) corresponds in its formation with many other bars at the entrances to enclosed basins made by beaches formed by littoral sands extending across the points of headlands. The treatment of such is well established in practice to be the erection of jetties to stop the motion of the littoral sand, and concentrate the action of the tidal currents to scour and maintain a channel between them. Generally a jetty on each side is required; but sometimes one will suffice, and one can generally be tried with safety to the project, and let the necessity for the other be determined by the result. This seems to be the case at Nantucket. As early as 1828 Mr. Zenas Coffin of Nantucket—a man of wealth, whose descendants are still there—contemplated driving a row of piles from Coatue Point, on the east side of the entrance, and talked about it so that it is well known and remembered. Other Nantucket men have suggested to me a jetty here too.

In regard to the use of piles, I do not think they will answer except as an auxiliary, for the ice in winter might move them bodily.

I, however, prefer the placing of the jetty on the west side of the entrance, keeping during its erection such a watch upon Coatue Point that no injurious change shall occur there.

The jetty I propose is to be triangular in section, with side slopes of 45 degrees; the top to be 5 feet above mean low water for a distance of 4,000 feet from the shore; the outer 2,500, being more exposed to the action of the waves, should be 4 feet wide on top, with the same side slopes, and the same height. The outer end, or head, being in deeper water, should have increased dimensions to meet the greater shock of the waves and effect of ice to which it will be exposed. The jetty is to be of large riprap stone, dropped immediately upon the line of the work; or, as it is a shallow bar and much exposed, it may be better to land the stone inside the harbor on Brant Point, and lay a railway track (probably a mile long), carry the stone to the point on the shore where the jetty is to begin (see Diagram A), continue the railway on piles out along the line of the jetty, and drop the stone as the track advances.

The following is the estimated cost of a jetty of the above description:—

First section, 4,000 feet, 7 tons of riprap per linear foot, stone to average $1\frac{1}{2}$ tons, 28,000 tons.

Second section, 2,500 feet, 12 tons per linear foot, stone to average $1\frac{1}{2}$ tons, 30,000 tons.

Total, 58,000 tons, at \$1.75	.	.	.	.	.	.	.	.	.	\$101,500 00
Add for contingencies	.	.	.	.	.	.	.	.	.	10,500 00

112,000 00

It is thought that this improvement could be carried on to ultimately increase the depth to 12 to 14 feet or more; but to do this a second jetty may be required, which, in general terms, may double this estimate.

No benefit could result unless at least one jetty was completed: so it is urged, if the plan proposed to improve the present entrance is attempted, that the whole amount for the first jetty be appropriated in one, or, at most, two years.

Recapitulation of Estimates.

First, For a channel through the Haulover, 10 feet wide and 2 feet deep at mean low water, \$1,200.

Second, For a channel through the Haulover, 6 feet deep and 100 feet wide, and for a channel 6 feet deep thence to the wharves, \$32,000.

Third, For a jetty on the west side of the entrance to the harbor to increase the depth on the bar, \$112,000.

[B.]

WORK IN WOOD'S HOLL STRAITS.

The principal work has been in widening and straightening what is known as the Lone Rock Channel, which passes between Grassy Island on the north and Red Ledge on the south, and which was before the work commenced not more than 30 or 40 feet wide and very crooked. It is now direct and 120 feet in width, with a depth of not less than 9 feet at mean low water ; and 140 feet wide, $7\frac{1}{2}$ feet deep, at same time of tide.

Although what has already been done has greatly facilitated the passage of the Wood's Holl Strait by the passenger steamboats now running through it, the channel should still further be enlarged for the use of the government steam-vessels and the more general class of coasting-steamers, as originally designed; and there can be no doubt that the full plan of enlargement for sailing-vessels should also be prosecuted to completion.

Work proposed for the Fiscal Year ending June 30, 1881.

Work will be continued until the funds available are expended in widening the present channel by removing bowlders.

No appropriation was made for this work by Act of June 14, 1880, and nothing further can be undertaken.

To make the steamboat channel 200 feet wide and 9 feet deep at low water, the original estimate was \$22,000, and will require an additional appropriation of \$12,000. The work is of such a nature that any expenditure upon it is a part of the final improvement designed and estimated for the use of sailing-vessels. The amount that could be advantageously expended on this work in the fiscal year ending June 30, 1882, is \$50,000. It is recommended that this amount be appropriated.

[C.]

SURVEY OF WAREHAM HARBOR, MASSACHUSETTS.

General Description of the Harbor.

This harbor is an estuary of Buzzard's Bay. It is about 13 miles east of New Bedford, and 6 miles west of Monumet, the southern end of the proposed Cape Cod Ship Canal.

It is about 3 miles in length, with a width varying from 200 feet to more than $\frac{1}{2}$ a mile.

Into this estuary empty Agawan River at its head, draining about 45 square miles; Broad Marsh River on the west side, draining 4 square miles; and Weweantic River on the west side, below Long Beach, draining 95 square miles.

A small stream, called Crooked River, draining but 1 square mile, empties into it from the east.

The shores for the most part are low, with extensive marshes that are submerged by spring tides.

The harbor, commencing at the rail and highway bridges at Wareham, which, not being provided with draws, prevent any navigation above them except by barges, is about 200 feet wide. At the south end of the Franconia Iron Company's Wharf, 1,400 feet further down, it is 400 feet wide; from this point it opens out into a bay 2,000 feet in width. Near the mouth of Broad Marsh River it narrows to about 900 feet, which width it retains for about 1,200 feet, when it again widens into a bay more than $\frac{1}{2}$ a mile wide.

This bay is separated from Buzzard's Bay by Long Beach, which extends from the east shore out about 2,000 feet. This beach is composed of sand. At low-water level the sand is coarse, with gravel and pebbles; above low water it is fine, and easily moved by wind or waves. The width of the beach at low water varies from 200 to 800 feet; at ordinary high water a narrow strip of sand, not more than 100 feet wide in the widest part, is above water. At high water of spring tides the whole beach is submerged.

Outside of this beach is an extensive shoal or flat, the curve of 6-foot depth being $\frac{1}{4}$ of a mile distant at the east end, and more than $\frac{1}{2}$ a mile at the west end. The water on the inside of this beach is bold; at the west end of it a vessel drawing 9 feet can at low water approach within 50 feet of the high-water line.

Previous Surveys.

A survey of this harbor was made in 1870 under direction of the Harbor Commissioners of Massachusetts. The report upon this survey appears in their Fifth Annual Report, 1871, and is as follows:—

“During the past year the Board has had made a careful survey of Wareham River, with a view to the establishing proper harbor-lines, and the determination of the causes that have led to the formation of shoals near the wharves. They also have in mind to apply to Congress for the removal of the bar that has formed at the mouth of the river, should the

results seem to justify such action. The great importance of this port, and the extensive manufactures carried on there, call for a serious effort to improve the navigation of this river, upon which the prosperity of the place almost wholly depends."

In their next annual report a comparison is made between the condition of the harbor in 1845, as shown by the United States Coast Survey, and by their survey of 1870. This comparison showed that marked changes had taken place in the upper part of the river. Of this they say, "It can hardly be questioned that the construction of the solid pier between the west side of the river and the sluice-way, or bay, through which scows and boats now pass, and the solid embankment of Cape Cod Railroad on the west side of the river, together with the stone ballast which has been thrown around and between the piers of both the railroad and town bridges, have contributed mainly to the injury sustained, and have caused the violent and unequal currents which have dug out, as it were, the deep holes above, between, and below the bridges, and thrown up the abrupt and injurious shoals beyond them."

The injurious effects of the bridge structures they think is "confined to about the first 400 feet below them."

In regard to these they say, "While there is no doubt that the physical condition of this upper portion of the river could be improved by the removal of the railroad embankment, the whole, or a part, of the solid pier near the centre of the river, the stone ballast from under each of the bridges, and the reconstruction of the railroad piers, it would be a measure of doubtful economy. It is the opinion of the Board, that the river could be improved, and the improvement maintained, for a much less sum than it would take to remove and remodel the objectionable portions of the existing structures."

Harbor-lines were established by the Board on both sides of the river from the bridges at the upper end to Barney Point.

In 1871 a survey was made under direction of Gen. George Thom, United States Engineer, in accordance with a resolution of the House of Representatives. The report upon this survey, including estimates for improving the channel, was published in the Annual Report of the Chief of Engineers for 1872, pp. 973-976.

The map of the survey of the harbor, made in 1870 by Professor H. L. Whiting for the Harbor Commissioners, was used as a basis for the survey of 1871 under Gen. Thom. Additional soundings were taken, and current observations made on the flood and ebb tides at the railroad bridge and at Quahaug Bar. The soundings were reduced to the plane of mean low water established in 1870.

The plan of improvement estimated for and recommended by Gen. Thom was dredging a channel 250 feet wide and 9 feet deep at mean low water through Quahaug Bar, and straightening and widening the channel through the "upper bar;" estimate was also made for removing a large boulder near the mouth of Weweantic River, — the whole to cost \$45,000.

History of Improvements made.

In 1872 Congress made an appropriation of \$10,000 for the improvement of this harbor; another appropriation of \$10,000 was made in 1873, \$10,000 in 1874, and \$10,000 in 1875: making a total of \$40,000. Dredging was commenced in 1873, and completed in 1876, making a channel from 250 to 300 feet wide and 10 feet deep at mean low water from Long Beach around Quahaug Bar; thence, by cutting off shoal points, a least width of 200 feet was made to the "upper bar." Thence to the bridge, at the upper end of the harbor, the width decreased to 100 feet; the depth made in this part was 9 feet at mean low water.

During the progress of the improvement in 1873, a detailed survey of the harbor was made, as the maps of previous surveys were not sufficiently in detail to serve as a guide in carrying on the works of improvement. This survey showed that there was less depth of water in the harbor than had been previously supposed.

The report of this survey was published in the Annual Report of the Chief of Engineers for 1874, pp. 216-220.

On the completion of the improvement above described, there was about \$1,700 remaining on hand. With this an attempt was made, in 1877, to catch the sand brought along the south side and over Long Beach into the harbor, by building a sand-catch fence. This fence was of a single row of cedar-trees on the higher parts, and on the lower parts of two rows of posts 4 feet apart, connected by stringers and ties placed 1 foot below the surface of the sand. The space between these two rows of posts was filled with brush to about 2 feet above the general surface, this brush being held in place by small stone.

In a storm, accompanied by a very high tide, in the following October, a portion of this fence was washed away. In July, 1878, it was rebuilt, and loaded with larger stone.

The removal of the boulder in Weweantic River, estimated for in the report of Gen. Thom, was not undertaken, because there was no longer any demand for it.

Survey and Map.

The survey of this season was confined to the channel dredged in 1873-1876, and to the part outside of Long Beach not included in previous surveys. A map of the harbor from the bridges to the "four buoys," outside of Long Beach, on a scale of 200 feet to an inch, accompanies this report. This map shows the present condition of the channel, the depth on the flats and in coves from survey in 1873, the harbor-lines as established by the Harbor Commissioners in 1871, and the channel desired by those interested in the commerce of Wareham and for which estimates are made.

Present Condition of the Harbor.

Beginning at the bridges at the upper end of the harbor, we find in the deep hole, which is undoubtedly caused by the obstruction formed by the embankments, and piers, and riprap protection of the bridges, a depth of

26 feet at mean low water, the same as in 1873. Immediately below this, the shoal with the dredged channel along the wharves to the west has a depth of but 4.1 feet on it. This shoal has increased in size, and now encroaches upon the channel, leaving a width of but 70 feet with 8 feet depth.

From this shoal to the "upper bar," which begins about 900 feet below the Franconia Iron Company's Wharf, the dredged channel has about the same general width and depth as when completed. In some places it has widened by scour, and in some narrowed by deposit.

The channel dredged through the "upper bar," 150 feet wide, and from 9 to 10 feet deep at mean low water, has filled up so that in the shallowest place there is but little more than 7 feet depth at mean low water. This filling is over the whole width of the channel, and for 600 feet along it.

From this bar to the entrance of the harbor at Long Beach but little change has taken place in the dredged channel.

At Quahaug Bar it has narrowed somewhat by filling in from the bar or north-west side of the channel, and widened on the opposite side by scour.

There is now a channel not less than 100 feet wide, and 9 feet deep at mean low water, from the entrance to the "upper bar." The mean rise of tide is about 4 feet, so that vessels drawing about 13 feet can go to the "upper bar" at mean high water, but cannot cross it drawing more than 11.5 feet.

The fence on Long Beach, built to catch the moving sand, is in very good condition, and for much of its length sand has collected about it nearly up to the level of high water. On the part of the beach above ordinary high water, the sand is blown about by the wind so that its height is not much increased by the fence. A storm from the south will fill the sand in along the fence that will be blown out into the water by a northerly wind.

Proposed Improvement.

From a consultation with those interested in the navigation of this harbor, I learned that the depth of the channel made in 1873-76 was deemed by them sufficient for the class of vessels likely to be employed in the commerce of the place if that depth can be maintained.

The width of channel made, they say, is too small to allow vessels to beat in or out, and for this reason valuable time is lost by vessels that come to this port.

This want of width for beating is particularly felt above Barney Point and through the "upper bar." Some trouble is found in getting through the channel at Quahaug Bar, but less than in the upper part.

To meet these requirements will require that the channel through the "upper bar" be made 350 feet wide. The entire removal of the "upper bar" is wanted by those interested, so as to make the pocket of deep water to the east, now used for anchoring boats in, available for beating in; but the harbor-lines, as established, place part of this pocket of deep water inside of the pier-head line.

Estimate is made for dredging the entire space on the "upper bar" east of the present channel to the harbor-line on the east side. This would give a width of 350 feet. This is a greater width than is proposed below, and will require the removal of a large amount of material. We have therefore made an estimate for a channel 200 feet wide through this bar; thence to Barney Point, to widen and straighten the channel to 200 feet, and 10 feet depth; from Barney Point to the entrance of the harbor, to make the channel 250 feet wide in its narrowest part, and 10 feet deep.

A depth of 10 feet is made, so that, when the sides of the cuts are washed down by the waves and by vessels striking them, there will still be a least depth of 9 feet.

The fence already built on Long Beach seems to have determined the feasibility of holding and building up this beach above high water, and in that way cut off one of the sources of supply of sand that now finds its way into the harbor.

The growth of the shoal, of which this beach is the inner margin, and its encroachment upon the lower part of the harbor, have been considerable within the memory of those who sail out of the harbor. A map of Wareham, made by S. Bourne in 1832, shows a wide opening near the eastern shore, and a shoal outside of it. Through this opening, boats went in and out to the fishing-grounds.

This map does not give the depth of water. The map of the United States Coast Survey, made in 1845, is the earliest one on which the depth of water is shown. Since that date the filling has been going on slowly; but the beach is not likely to become permanent unless it is raised above storm-tides, and the sand held against the action of the winds by vegetation.

To do this it will be necessary to build a sand-catcher on the site of the present fence: this to be of brush loaded with stone. It should be built above storm-tides. From this spurs should be built on the south side: these would not require to be so high or strong as the main line. They should be built by beginning at the lowest point of the beach, and building one at first. When the sand fills out to the end of it, another may be built, and so on until the whole beach is widened and raised. As soon as any portion of the beach is above spring tides, it should be planted with beach-grass to prevent the sand being blown away.

Some complaint is made of the narrow channel at the "four buoys," about $\frac{3}{4}$ of a mile below the "beach." An examination of it showed a channel 12 feet deep at mean low water, with a least width of 125 feet, with boulders on either side of it.

We could not learn that any serious trouble had been experienced here; and, as it is better than we propose to make the channel farther up the harbor, no estimate is made for its improvement.

Pilots find some trouble into the harbor in thick weather, or near night, from their inability to see the westerly end of Long Beach. If they cannot see it, and get out of their course to the eastward, they get ashore on the Long Beach flats. It is thought that a "day beacon" should be built on the west end of the "beach," and thus this danger avoided or lessened.

Estimates.

FIRST ESTIMATE.

Dredging 60,000 cubic yards from channel near bridge, and through "upper bar," 350 feet wide, mud and sand, at 25 cents . . .	\$15,000 00
Dredging 15,000 cubic yards, in widening the channel from "upper bar" to Barney Point, mud and sand, at 25 cents . . .	3,750 00
Dredging 24,000 cubic yards of sand, in widening the channel at Quahaug Bar	6,000 00
Removal of bowlder from channel upper side of Quahaug Bar . .	300 00
For holding Long Beach, 2,000 cords of brush, in place, at \$2 . .	4,000 00
4,000 tons of stone on beach, at \$2	8,000 00
Building spurs, 20, at \$100	2,000 00
Planting beach	1,000 00
Add for contingencies	4,000 00
Total	\$44,050 00

SECOND ESTIMATE.

Same as the first, except the channel through the "upper bar" is 200 feet wide, instead of 350.	
Dredging 36,000 cubic yards from channel near bridge, and through "upper bar"	\$9,000 00
The other items, same as in first estimate	25,050 00
	\$34,050 00
Add for contingencies	4,000 00
	\$38,050 00

[D.]

IMPROVEMENT OF TAUNTON RIVER.

Work proposed for the Fiscal Year ending June 30, 1881.

With the appropriation of \$17,500, made by Act of Congress approved June 14, 1880, it is proposed to begin the improvement as planned for in the above report; viz., "to secure 11 feet of water at mean high tide up to the Weir Bridge," by commencing at the bridge, and working down river.

The work to be done by contract with the lowest bidder, after advertising for proposals in the usual manner.

Respectfully submitted.

G. K. WARREN,
*Lieutenant-Colonel of Engineers,
Bvt. Major-General.*

ANNUAL REPORT

OF THE

Mass.
HARBOR AND LAND COMMISSIONERS,

FOR

THE YEAR 1881.

BOSTON:

Rand, Avery, & Co., Printers to the Commonwealth,

117 FRANKLIN STREET.

1882.

Commonwealth of Massachusetts.

HARBOR AND LAND COMMISSIONERS' REPORT.

To the Honorable the Senate, and the House of Representatives of the Commonwealth of Massachusetts.

THE Board of Harbor and Land Commissioners, in accordance with the provisions of law, respectfully submit their Annual Report for the year 1881.

SOUTH BOSTON FLATS.

The reclamation of land lying easterly of that heretofore sold to the Boston and Albany Railroad Company and to the New York and New England Railroad Company has made good progress during the year. About two hundred and fifty thousand yards of material dredged from the harbor under operations of the General Government and of private parties have been deposited on the flats lying immediately east of B Street. This has been accomplished at very small expense to the Commonwealth for the construction of bulkheads to retain the filling and for superintending the dumping.

Only a small quantity of material has been deposited under the contract of Aug. 28, 1880, with Thomas Potter, for three hundred thousand cubic yards; but the contractor promises that the entire quantity shall be deposited before Jan. 1, 1883, the time required by the contract.

Under the appropriation of five hundred thousand dollars made last year, the Board decided to obtain as much filling as practicable, using no part of the appropriation for the con-

struction of piers. Several considerations operated to lead to this decision. By prosecuting the filling as rapidly as possible, the removal of the remainder of the shoal lying in front of the territory already reclaimed will be accomplished at the earliest time practicable. The filling required must be done before any piers which could be constructed would be available for use, and the filling is of necessity a slow process. The great advance which has been made in appliances for the transaction of large business warns us that it must not be assumed that this advance has ceased. Piers and docks planned to meet the most approved methods of to-day might not be all that would be demanded five years hence, and the special needs of those who shall occupy the premises must largely determine what will be required for docks and piers.

A contract was made in August with the New England Dredging Company to dredge and deposit upon the flats to be reclaimed nine hundred thousand cubic yards of material within four years from the approval of the contract. Work was begun immediately under this contract, and is progressing satisfactorily. It will require the removal of only seven hundred thousand cubic yards to take away all that remains of the shoal lying between the channel in front of the reclaimed territory and the main channel, and give twenty-three feet depth at mean low water from East Boston piers to South Boston sea-wall. On the completion of the two contracts now in progress, this depth will be secured, twelve or thirteen hundred feet easterly of what is known as the fifty-acre piece, covering all the frontage now reclaimed and all that will be reclaimed by the material obtained from this dredging. The material obtained under the Potter contract is being deposited next easterly of the fifty-acre piece, and will raise to grade thirteen an area of about fifteen acres; that obtained under the contract with the New England Dredging Company is being deposited, a part immediately easterly of the area covered by the Potter contract, and a part in the rear of this and of the Potter area, and will raise to grade thirteen a further area of about forty-three acres. The area lying between the last-mentioned area and the present line of riparian ownership comprises about thirty-seven acres, and is likely to be filled from miscellaneous sources already mentioned by the time the filling in front is com-

pleted. The filling under the Potter contract and the New England Dredging Company contract is all placed south of a bulkhead erected thirteen hundred feet in rear of the front line of occupation, leaving ample room for the construction of docks and piers twelve hundred feet long. The area left for docks and piers comprises about forty acres, making a total of one hundred and thirty-five acres available for occupation when these are constructed.

The contract with the New England Dredging Company amounts to \$434,000, which with the minor contracts for bulkheads, the completion of B Street, engineer and other expenses attending execution of the work, will substantially exhaust the existing appropriation; but it is not now seen that there would be advantage in entering upon other contracts of importance the ensuing year.

There are still some fractional interests in the area which the Commonwealth attempted to purchase between B and E Streets under the provisions of chap. 446 of the Acts of 1869, which are not yet acquired. $\frac{3}{80}$ of one lot and $\frac{1}{7}$ of another are outstanding. At the price paid for the interests purchased, these outstanding interests amount to \$5,234. The original appropriation having expired, a new appropriation of ten thousand dollars was made by resolve, chap. 61, of 1877, but limited so that no part of the appropriation could be used unless all the outstanding interests were secured. The larger interest could be secured on the same terms as those already purchased, but the smaller could not. Two years later, by chap. 170 of the Acts of 1869, it was provided that three thousand three hundred dollars might be used. This would have been sufficient to have purchased the larger outstanding interest; but during the delay litigation had arisen between the owner and a mortgagee, which suspended negotiation, and the appropriation again expired. The Board recommend a renewal of the appropriation made by the Act of 1877, but without the limitation which imposed the necessity of acquiring all or none.

A contract has been made with the New York and New England Railroad Company for covering B Street with gravel at fifty cents per cubic yard, and the tracks are laid for the execution of the work.

BACK BAY LANDS.

	FEET.
In 1857 the Commonwealth owned on the Back Bay .	4,723,998
Of which there have been donated	363,308
Devoted to streets and passage-ways	2,037,068.60
Sold as per last report	2,195,789.05
Sold in 1881	25,238.75
	<u>2,221,027.80</u>
Remaining for sale Dec. 31, 1881	102,593.60
	<u><u>4,723,998</u></u>

The gross proceeds of land sold as per last report	\$4,623,087 02	
The gross proceeds in 1881	83,549 75	
	<u>\$4,706,636 77</u>	
Rights in Parker Street as per last report	2,300 00	
	<u>\$4,708,936 77</u>	

Cost of filling, grading, etc., as per last report	\$1,626,008 71	
Cost of auction sales as per last report	14,291 78	
	<u>\$1,640,300 49</u>	
Net proceeds to Dec. 31, 1881	\$3,068,636 28	

There has been sold in 1881 as follows:—

2,800 feet Marlborough Street, north side, for	\$11,200 00	
3174 $\frac{3}{4}$ feet Commonwealth Avenue, south side	15,873 75	
19,264 feet Newbury Street, north side	56,476 00	
	<u>\$83,549 75</u>	

The average price per foot obtained was \$3.31, the lowest price \$2.75, and the highest price \$5.

The sales have been much less than last year ; but there has been no decrease in prices, and the amount of land remaining unsold is so small that no apprehension is felt that as good prices will not be obtained for all that remains.

The land unsold is located as follows:—

Marlborough Street, north side	16,777.6	
Commonwealth Avenue, south side	3,237	
Newbury Street, north side	12,320	
Newbury Street, south side	26,208	
Boylston Street, north side	36,176	
Boylston Street, south side	7,875	
	<u>102,593 6</u>	

The value of the remaining land cannot be less than \$250,000.

By chap. 185 of the Acts of 1875 for the laying-out of public parks in or near the city of Boston, it was provided that any real estate in the city of Boston, which in the opinion of said Board shall receive any benefit and advantage from the locating and laying-out of a park under the provisions of this Act, beyond the general advantages to all real estate in the city of Boston, may, after like notice to all parties interested as is provided by law, to be given by the street commissioners of the city of Boston in cases of laying out streets in said city, be assessed by said Board for a proportional share of the expense of such location and laying out; provided, that the entire amount so assessed upon any estate shall not exceed one-half of the amount which said Board shall adjudge to be the whole benefit received by it. The terms of this provision are certainly sufficiently general and sweeping to include the State House and all the land of the Commonwealth, if no exception is implied. The principle that the property of the Commonwealth is exempt from taxation independent of statute exemptions has been long established, and applied by the court of last resort to taxation for local improvements of a public nature as well as to taxation for general public purposes (116 Mass., 193); and, if the Legislature had intended that the general language of the statute should be construed to include any land of the Commonwealth, it would probably have provided that some agent of the Commonwealth should have authority to pay the assessment on such land. The failure to make such provision, and the fact that the only method of collection provided was by sale of the land assessed, would seem conclusive that it was not intended to make an exception to the general principle, were it not that a different view has been taken by the commissioners acting under the statute, and assessments have been actually made upon land of the Commonwealth on the Back Bay amounting to \$13,495.75. More than half this amount was assessed upon land which had been bargained by the Commonwealth before the park was laid out, and which the Commonwealth was under obligation to convey at a price fixed, and which could not be increased by reason of any effect of the park. Legal proceedings have been instituted by the Attorney-General to test the validity of these assessments, and it is probable that no legislation

will be required. It is proper, however, that the matter should be brought to the attention of the Legislature. If the Commonwealth had not contributed otherwise to the construction of the parks of the city, it might be said that the same equity existed for subjecting the vendible lands of the State to assessment for park construction as existed for subjecting land of citizens to such assessments; but on consideration of all the facts it will be seen that the Commonwealth will not have been wanting in liberal action toward the parks if the general principle so unquestionably sound is allowed to operate undisturbed. By chap. 92 of the Acts of 1881 the Commonwealth authorized the use for park purposes, under the Act of 1875, of 133,400 feet of land lying in Charles River Basin, the money value of which was many times the amount of the assessments in question. By chap. 247 of the Acts of 1866 a grant was made to the city of Boston for similar purposes, though of less extent.

TIDE-LANDS.

There has been received during the year, for land of the Commonwealth occupied by wharves and other structures in tide-water, the sum of \$58,663.75. This amount is much larger than has been received in any previous year since the passage of the Statute of 1874 under which these sums are received.

HARBOR LINES.

In the reports of the Board for 1878 and 1879, the subject of harbor lines for the inner harbor of Boston was presented; and in the latter report, 1879, a scheme was submitted and a description prepared of a series of lines along the frontage of the city proper, from Dover-street Bridge to West Boston Bridge, and of the westerly side of Charles River from West Boston Bridge to the Navy Yard. These lines, as reported and described, were afterwards, by chap. 170 of the Acts of 1880, established as harbor lines.

In accordance with the original intention and general plan proposed, the Board has made a further study and prepared a scheme of lines for the frontage of East Boston from Meridian-street Bridge on Chelsea Creek to Pier No. 4 of the Grand Junction Wharves on the northerly side of the main basin of the inner harbor. A detailed description of these lines is given below.

In confining the project now submitted to the portion of the harbor frontage included within its range, the Board has been guided by considerations of public interest in prescribing lines for those parts of the harbor where improvements and the development of the business occupation of the frontage required the direction and limitation of proposed and progressing structures.

The south-easterly frontage of Charlestown and the westerly side of Chelsea Creek are already well defined by the substantial sea-walls of the United States and those built by the Mystic River Improvement Company. The former have been long in place, and the latter conform to established harbor lines which require no re-statement.

No commercial exigency demands an immediate revision of that part of the frontage of the city of Chelsea lying between Chelsea and Meridian-street Bridges. This part of the water-front of the harbor may, however, require future modification; but it should be made in connection with a comprehensive study of the physical and commercial and economic capabilities of the Mystic River above Chelsea Bridge and of Chelsea Creek above Meridian-street Bridge. The Board has not yet had opportunity (nor means) to make the necessary examinations and surveys upon which such a study should be based, and therefore presents, at this time, no scheme therefor.

In their last Annual Report the Board gave a brief account of the imperfect condition of the harbor line of East Boston, with some explanation of the causes which had led to it, and expressed the opinion, that, while some of the wharves extended beyond the present harbor line, others might be extended without injury to the harbor, and at the same time afford additional commercial facilities of value to the port. A remedy for these defects was suggested, or a mode of dealing with special cases like that of the Boston and Albany Railroad Company, which seemed to the Board a safe and practicable one. No action was taken, however, upon these suggestions; and the difficulties of the situation will be only in part removed by the revision herein recommended: but the Board deem it inexpedient to revise the harbor lines eastwardly beyond Pier 4 of the Grand Junction Wharves at the present time. Legal notice was given, and a hearing

appointed upon the subject of defining the line of frontage between the locality above named and Point Shirley. The hearing was quite fully attended, and large landed and commercial interests were represented. The Board had previously prepared, in their office, a preliminary plan for the general development of this ground; but no other scheme was offered, or plan presented, with which any proper adjustment could be effected, or which harmonized with the present views of the Board. Their experience has proved the value of careful deliberation and cautious action in dealing with schemes which will require long periods of time for execution. The study of such subjects includes, not only perfecting provisional plans for the preservation and improvement of the natural features and functions of a harbor, but often involves important questions of *change*, in regimen and otherwise, which are the more difficult and critical to determine properly. The numerous islands and extensive flats and shoals, and the many natural channel-ways between them, which characterize Boston Harbor, particularly the north-eastern part of it, offer favorable ground for treatment; but it should be dealt with in the most judicious and comprehensive manner. The want of plan and system, in much that was done before organized supervision was established, resulted, not only in the imperfect utilization of many natural advantages, but in serious and irreparable injury.

In determining the scheme of the South Boston Flats improvement, the best available advice was sought, and the best practicable data obtained concerning it. The surveys upon which the outline of the project of improvement was based cost many thousand dollars, and the study of the problems involved was the work of many years. The wisdom of this course has been fully proved by the success of each stage of progress in the work.

Of not less importance, physically and commercially, is the line of frontage, with its outlying flats, between East Boston and Point Shirley. This ground presents many advantageous features, and ample space exists for the location of extensive docks by taking advantage of the natural depths and channel-ways. A scheme for the proper development of this portion of the harbor is a project of about equal magnitude to the South Boston Flats improvement.

The improvement of the frontage between Castle Island and Commercial Point would be also a great addition to the maritime business territory of the port. This line of frontage would be somewhat more exposed than the East Boston and Point Shirley side ; but the ground naturally admits of docks of any desirable magnitude, with extensive flats and marshes in the rear, which can be filled and utilized for commercial purposes. These lines of frontage on either side of the harbor are each open to approaches by the main channel below the harbor “middle grounds,” and each have direct communication with the anchorage of President Roads. With comparatively slight dredging these lines of frontage will afford a general depth of fifteen feet at mean low tide, and on portions of each line a depth of from twenty to twenty-three feet can be obtained.

Much has been said on the subject of artificial docks in connection with the improvement of Boston Harbor, using this term to designate enclosed basins, which may have within their limits a number of single slips ; but no such work seems to be needed. The main inner basin is a natural dock of itself. In fact, the area of sheltered water, as an inner harbor, is of much larger extent than the community in general are aware. The term “inner harbor” is generally applied to the smaller basin above Governor’s and Castle Islands and below the bridges, which contains, within the limits of projected improvements, about 1,150 acres. But what is really the *inner harbor*, or may be properly so regarded, is the general area which comprises the water-spaces, including this upper basin, which are enclosed and protected by the high grounds of East Boston and Winthrop on the north, Deer Island and Long Island on the east, and Spectacle Island, Moon Head, and Squantum, on the south, — a nearly land-locked basin, capable of an improved area of not less than about 6,300 acres. This includes President Roads, which in itself contains nearly one thousand acres of anchorage ground of the *first order* as to depth of water (twenty-three to fifty feet at mean low tide), “holding-ground,” and shelter. The width of entrance (between Deer Island spit and Long Island head) to this larger inner basin is less in proportion to the water-space enclosed than the entrance to the smaller basin above. It has a natural depth of over fifty

feet, while the entrance to the upper basin has had to be artificially deepened by the General Government to twenty-three feet. The area of this larger portion of the inner harbor, exclusive of the 1,150 acres above Governor's and Castle Islands, is about 5,150 acres. The examination of any approximately accurate chart of Boston Harbor will show at once the relative proportions, situation, and surroundings of the respective water-spaces.

Various opinions have been expressed concerning some of the features of the upper basin, particularly in regard to Bird Island shoal and the channel or water-way between it and the south-easterly point of East Boston. The Board are not in possession of sufficiently recent or accurate data to speak unqualifiedly in regard to these natural features. The channel-way just referred to was not considered by the United States Advisory Council for Boston Harbor of marked physical importance; nor is it one which can be used for even second-class navigation, as required to-day. Nature has determined the main inlet of this upper basin to be between Governor's and Castle Islands, where it has established a depth, in the narrower or more contracted section, of about twenty-seven feet at mean low tide. Its second natural pathway of flowage is between Bird Island shoal and Governor's Island, where it has established a depth at its narrowest section of about twenty-nine feet, with a least depth in the shallowest section of this lateral channel of about sixteen feet. The third inlet or water-way in point of natural consequence is the one above referred to, between Bird Island shoal and the main shore of East Boston, where nature has established a depth of but $9\frac{1}{2}$ feet at mean low tide. How far it may affect the regimen and physique of the harbor to widen and deepen this third-rate channel-way, and to what extent it may be done and not imperil the other channels, particularly the one upon which the General Government has expended so much time and money to improve, are questions of grave importance, which can only be solved by careful study and the calculation of the forces which may affect them.

With regard to the removal of Bird Island shoal by dredging, the scheme in the present opinion of the Board has many serious objections. The shoal answers now as a break-water in strong northerly and north-easterly winds, and pre-

vents what might be an injurious sea-dash upon the quay of the South Boston Flats. The southerly margin of the shoal is quite abrupt, and maintains a remarkable parallelism with the line of the South Boston quay, and exercises with it an important function in confining and directing the tidal currents in their inflow and outflow through the main channel.

The amount of space gained to the area of the upper basin by the removal of Bird Island shoal does not seem to be commensurate with the labor and cost of effecting it. It can hardly be said to be a necessity. The width of the basin between a line which may be made a line of frontage, similar to the South Boston Flats, and the quay of these flats, is about three thousand feet, which is about the same as the width of the Mersey in front of the great docks of Liverpool. The material of this shoal is *solid ground*, and in its natural state capable of sustaining the weight and pressure of any desired structure.

In the rear of Bird Island shoal and between it and Governor's and Apple Island and the main shores of East Boston and Winthrop, is a depressed area of flats traversed by three of the minor channel-ways which characterize this portion of the harbor. In this locality a basin six thousand by five thousand feet square, more than a square mile of area, can be created by the removal of less material, to the space and depth acquired, than would be necessary in any other part of the inner harbor where it could serve like purposes. Such a basin can be so located as to make the outline of at least two of its sides coincident with lines of commercial frontage of the first order.

There is probably no other harbor known to commerce which, in its natural conditions of configuration, marginal ground, basins, channels, entrance, and shelter, is capable of affording equal facilities in so concentrated a manner as the main inner basin of Boston Harbor. It is in general form a hollow square, on each available side of which natural channels mark natural lines of frontage of such a character that docks and piers can be constructed along these lines of any size and depth of approach and berth capacity within the range of the most diversified requirements and with a degree of economy and mechanical facility unparalleled in harbor qualifications. As before stated, these inner harbor basins

contain an area of about 6,300 acres. The preliminary plan prepared by the Board to illustrate the possibilities of the harbor shows that a simple and systematic arrangement could be effected for a series of docks 1,000 feet long and 300 feet wide with alternate piers of equal length and 250 feet wide. The quay of the South Boston Flats between Fort Point Channel and Castle Island admits of twenty such docks and twenty-one such piers, including those already built and in progress of building. According to the plan referred to, a quay can be projected, parallel to that of the South Boston Flats, extending from the termination of the present harbor line at East Boston in the alignment of and coincident with the southerly margin of Bird Island shoal to the abrupt, deep channel which marks its easterly limit. Along this line of frontage five docks and six piers can be provided; and along the southerly face of the shoal about 2,300 feet of quay can be extended; and upon the higher and firmer parts of the shoal the heaviest elevators can be constructed without uncertainty or excessive cost as to foundation. Along the line of quay the largest vessels could have ample berth. From the south-easterly point and termination of this quay a line of frontage at right angles with it can be extended northward along and coincident with the margin of the deep natural channel between Bird Island shoal and Governor's Island to a point in the general alignment of the northerly side of the natural channel which trends nearest to and is most nearly parallel with the shore line of Winthrop. Along this north-and-south line of quay, twelve docks and thirteen piers can be provided. From the northerly limit of this last-named line, and again at about right angles to it, a direct line of frontage can be extended to Point Shirley, along which seventeen docks and eighteen piers can be provided. This estimated number of docks and piers is exclusive of these already existing and in use, excepting those on the South Boston Flats. It is within the angle of these lines of frontage that a basin can be defined and excavated, as previously suggested; and such a basin should be an inseparable part, and is an absolutely necessary factor, in the development of first-class harbor facilities. It is a sacrifice of advantage in the treatment of such ground to extend fillings or excavations on either hand in excess of just that

equilibrium which is the measure of the most economical adjustment of terminal lands with approaches and access to them by channels and basins.

To recapitulate, it will be seen by such a general plan as the Board prepared as a preliminary study, that the total capacity of these remarkable basins within perfectly practicable means of accomplishment is about as follows : —

	DOCKS.	PIERS.
South Boston quay	20	21
East Boston south quay	5	6
East Boston east quay	12	13
Winthrop quay	17	18
	<hr/> 54	<hr/> 58

Each of these docks, as projected on the plan referred to, is estimated as capable of holding four first-class steamers of the present day, and the alternate piers to accommodate their shipping. It will be seen, therefore, that Boston can be made capable of receiving at one time within her port *two hundred and sixteen* of the largest vessels now afloat. There are no natural or practicable difficulties in making most of the docks suggested longer, wider, and deeper than has yet been contemplated. In fact, they can be so located and constructed that any steamer of any size or draught within the probabilities of construction can have berth accommodation and facilities. While the heavier vessels of the present time have now to wait in the open sea for the tide to lift them over the bars of New York and Philadelphia, they can pass into Boston Harbor without detention and without fear. By taking advantage of a channel not generally used, — the “Hypocrite Channel,” between Green and Calf Islands, — a depth of *forty feet* at mean low tide can be carried up to and into President Roads.

Unlike the long extended single line of frontage made necessary by the occupation of river-sites, like the Mersey and the Hudson, where the separation of business centres amounts to miles, the extreme extents of frontage in Boston Harbor, in its form of a hollow square, can be appropriately given in *feet*. The extent of what may be called the southerly basin, along its southerly face from the quay of the city to Castle Island, is about 10,200 feet, equal to about $1\frac{9}{10}$ miles. The north-

erly side, from the south-westerly point of East Boston to the south-easterly point of Bird Island shoal, is about 6,800 feet equal to about $1\frac{3}{10}$ miles. The width of this basin between these parallel quays is about three thousand feet. The easterly water-face of East Boston, according to the plan referred to, is about 7,500 feet, equal to about $1\frac{4\frac{2}{10}}{10}$ miles. The line of frontage along the water-face of Winthrop is about 9,100 feet, equal to about $1\frac{7}{10}$ miles. The distances between extreme points in the general extent of the inner harbor are about as follows:—

	MILES.
From the mouth of Fort Point Channel to Point Shirley, the longest distance from north-east to south-west extremes . . .	4
Mouth of Charles River to Castle Island	3
City quay to Castle Island	$2\frac{1}{2}$
City quay to south-east point of Bird Island	$1\frac{3}{8}$
North-west angle of northerly basin to centre of city quay . . .	$2\frac{1}{4}$
North-west angle of northerly basin to Castle Island	$2\frac{1}{4}$
North-west angle of northerly basin to Point Shirley	2
Point Shirley to Castle Island	$2\frac{1}{3}$
Northerly quay of northerly basin to southerly quay of southerly basin, through what may be called Bird Island Channel, — width of southerly basin, — about (3,000 feet) . . .	$\frac{57}{100}$

It will be seen, therefore, that the improvement and utilization of the harbor is a work of great magnitude, and as great importance, in the development of which the interests and responsibilities of the Commonwealth demand vigilant supervision.

While it may be unwise to impose too restrictive measures upon private enterprises, no scheme or plan of limited or special purpose should be allowed to prevent or injuriously affect the future development of more important public advantages. It may be and probably is impracticable to repair past injuries, but with acquired experience and better knowledge it would be *inexcusable* if gross mistakes should again occur.

The Board desire to emphasize the doctrine that no scheme of individual or corporate device should be permitted to prevail that is not in accord with the broadest view of the public claim and interest in the harbor.

It may not be out of place in this connection to quote from one of the unpublished able reports of Prof. Henry Mitchell,

of the United States Advisory Council for Boston Harbor, addressed to the Board of Harbor Commissioners when the subject of the protection of the headlands of the harbor was under consideration. Prof. Mitchell says, —

“ The great merit of Boston Harbor lies in a happy conjunction of many favorable elements, among which we may distinguish as most important the facility and safety of its approaches, the ample width and depth of its entrances, and, above all, the shelter and tranquillity of its roadsteads. Perhaps there is no other harbor in the world where the inlets from the ocean are better adjusted to the amplitude of the interior basins, or whose excellent holding-grounds are so easy of access and yet so land-locked. I quote from the highest authority in my profession when I declare that the primary requisite for a good harbor is that ‘ *the internal area should bear such a relation to the width of entrance as to produce a sufficient degree of tranquillity* ’ * And so difficult has it been to properly adjust this relation in artificial harbors, that nearly one-half of all these works may be set down as failures, because the entrances are either too narrow to admit vessels under trying circumstances, or the interior reservoirs too small to dissipate the waves that run in from the sea. In natural harbors, where the primary requisite, cited above, is fulfilled, it often happens that the interior basin is so large that the local effects of strong winds are sources of discomfort and even danger, as in San Francisco. Boston Harbor has no such drawbacks; her interior water-space is large, but is divided by chains of islands into basins which offer sufficient room for the heaviest ships to ride freely at anchor, and sufficient tranquillity for the frailest fishing-boat.

“ There are times when shelter from the wind is scarcely less important than smooth water. In the harbor of Cherbourg the in-run of the waves is most effectually arrested by the great mole, and yet nearly every vessel that sought shelter in the gale of 1865 was driven on shore by the wind. Here again Boston Harbor claims peculiar advantages: her moles are promontories and islands rising from twenty to one hundred feet above the sea.”

The following is the re-statement of the harbor line of East Boston, from Meridian-street Bridge to Pier No. 4 of the Grand Junction Wharves. The particulars of the re-statement are not in precisely the same form and terms as those of the harbor line of Boston city; but the data given are more concise than that first submitted.

* Stevenson on Harbors.

DESCRIPTION OF EAST BOSTON HARBOR LINE FROM MERIDIAN-STREET BRIDGE TO PIER 4 OF THE GRAND JUNCTION WHARVES.

Beginning at a point A on the westerly side of Meridian-street Bridge and about sixty-three feet southerly from the draw, and marked by a copper tack and an iron plate, in lat. $42^{\circ} 23' 06''.233$, long. $71^{\circ} 02' 02''.596$; thence straight south-westerly 817.9 feet to point B, in lat. $42^{\circ} 23' 01''.847$, long. $71^{\circ} 02' 11''.750$; thence straight more southerly 884.3 feet to point C near McKay's Wharf in lat. $42^{\circ} 22' 53''.663$, long. $71^{\circ} 02' 15''.875$; thence straight southerly and a little westerly 1,773.9 feet to point D, the north-westerly corner of Green's Wharf, in lat. $42^{\circ} 22' 36''.144$, long. $71^{\circ} 02' 16''.541$; thence straight southerly and a little more westerly 1,123.4 feet to point E nearly opposite Burnham's dry dock in lat. $42^{\circ} 22' 25''.210$, long. $71^{\circ} 02' 19''.109$; thence straight south-westerly 994.7 feet to point F, the north-westerly corner of Mayo's south wharf, in lat. $42^{\circ} 22' 16''.402$, long. $71^{\circ} 02' 24''.987$; thence southerly 474.6 feet on a curve of 512.3 feet radius tangent at F to the line EF and curving easterly to the point G in lat. $42^{\circ} 22' 11''.879$, long. $71^{\circ} 02' 24''.964$; thence straight south-easterly tangent at G to the curve FG 2,591.3 feet to the point H near the Eastern R.R. and Cunard Wharves in lat. $42^{\circ} 21' 49''.019$, long. $71^{\circ} 02' 09''.421$; thence more easterly along the front lines of the Cunard and Grand Junction Wharves 1,018.3 feet to the point I, the south-easterly corner of Pier 4, Grand Junction Wharves in lat. $42^{\circ} 21' 43''.888$, long. $71^{\circ} 01' 57''.753$.

Geographical Positions of Initial Points of the Harbor Line on the West and South Water-Front of East Boston from Meridian-street Bridge to the South-easterly Corner of Pier Four of the Grand Junction Wharves.

Station.	Latitude.		Longitude.		Azimuth.		To Station.	Back Azimuth.		Distance Meters.	Log. Meters.	Distance Feet.	Log. Feet.
	Deg.	Min.	Sec.	Deg.	Min.	Sec.		Deg.	Min.	Sec.			
A .	42	23	06.233	71	02	02.596		237	07	26	249.30	2.3967170	817.9
B .	42	23	01.847	71	02	11.750		200	29	20	269.55	2.4306374	884.3
C .	42	22	53.663	71	02	15.875		181	32	57	540.70	2.7329566	1773.9
D .	42	22	36.144	71	02	16.541		189	52	42	342.42	2.5345546	1123.4
E .	42	22	25.210	71	02	19.109		206	19	37	303.20	2.4817267	994.7
F .	42	22	16.402	71	02	24.987		R=156.15 Met.			144.68	2.1604007	474.6
G .	42	22	11.879	71	02	24.964		153	14	38	789.85	2.8975454	2591.3
H .	42	21	49.019	71	02	09.421		120	40	07	310.37	2.4918853	1018.3
I .	42	21	43.888	71	01	57.753							

Geographical Positions of Reference Points and Bearings and Distances connecting them with the Initial Points of the Harbor Lines of East Boston from Meridian-street Bridge to Pier Four of the Grand Junction Wharves.

Refer- ence Points.	LOCATION.	Latitude.	Longitude.	Distance Meters.	Log. Meters.	Distance Feet.	Log. Feet.	Azimuth.	Back Azimuth.	Initial Points.
A	Meridian-street Bridge about 63 feet south of draw opening	Deg. Min. Sec. 42 23 06.233	Deg. Min. Sec 71 02 02.596	-	-	-	-	Deg. Min. Sec. -	Deg. Min. Sec. -	-
C'	McKay's Wharf	42 22 53.615	71 02 14.935	21.55	1.3334851	70.7	1.8494528	93 56 25	273 56 24	C
D'	Green's Wharf	42 22 36.130	71 02 16.478	1.51	0.1777592	4.9	0.6937269	107 13 30	287 13 30	D
E'	Burnham's Dry Dock Wharf	42 22 23.855	71 02 17.477	56.05	1.7485678	183.9	2.2645355	138 14 01	318 14 00	E
E''	Burnham's Marine R'way Wharf,	42 22 23 494	71 02 19.738	54.86	1.7392810	180.0	2.2552487	195 12 18	15 12 18	E
F'	Mayo's South Wharf	42 22 16.350	71 02 24.964	1.69	0.2291071	5.6	0.7450748	161 26 23	341 26 23	F
G'	Whidden's Wharf	42 22 12.924	71 02 25.290	33.09	1.5197235	108.6	2.0356912	346 58 30	166 58 30	G
G''	Potter & Wrightington's Wharf,	42 22 10.830	71 02 23.843	41.29	1.6158803	135.5	2.1318480	141 36 22	321 36 22	G
H'	Eastern Railroad Wharf	42 21 49.928	71 02 09.814	29.45	1.4690992	96.6	1.9850669	342 13 22	162 13 22	H
H''	Cunard Wharf	42 21 48 552	71 02 08.287	29.68	1.4724333	97.4	1.9884010	119 02 40	299 02 38	H
I'	Pier 4, Grand Junction Wharves,	42 21 43.917	71 01 57.756	0.91	9.9590414	3.0	-	356 01 53	176 01 53	I

DRAWS IN THE BRIDGES ACROSS MERRIMACK RIVER BELOW HAVERHILL.

By the resolve chap. 23 of the Acts of 1881 the Board was instructed to investigate the subject, and report their conclusions in regard to widening the draws in the bridges across the Merrimack River below Haverhill.

In ascending the river from its mouth, the first bridge across it is the road-bridge between Newburyport and Salisbury, and the second the railroad-bridge of the Eastern Railroad Company; these two bridges are so near together that the draw-ways are connected by a continuous draw-pier and the passage-way through each bridge is about seventy feet in width. The draws and abutment-piers are in good condition. The plan and alignment of the connecting draw-pier, however, are not as well arranged for the passage of vessels through the bridges as the general location will admit. Owing to unsettled questions of obligation on the part of the city of Newburyport and the Eastern Railroad Company, this draw-pier has never been completed.

The third bridge in order across the river is the chain bridge, so called, between Newburyport and Salisbury. This bridge consists of two parts,—one a chain suspension bridge between the Newburyport shore and Deer Island; and the other, between Deer Island and the Salisbury shore, is composed of a wooden girder with arched lower chord next to Deer Island, and beyond it a leaf-draw and two short spans crossed by simple trusses.

The chain bridge is well built and in good repair, and the channel under it is used by steamers and other mast-less craft in preference to the draw-way opening.

The piers in the other part of the bridge are poorly designed, poorly built, and out of repair, being unnecessarily wide with square ends presented to the current, which create strong eddies in both the flood and ebb tides which set strongly against the southerly side of the draw-way so that the passage through it is difficult. The piers consist of a foundation of crib-work up to about high-water mark; and resting upon these is light trestle-work up to the level of the bridge and extending a short distance on either side of the draw to serve as draw-piers, but is not high enough to be

of the best service, and is much out of repair, and slowly pressing into and narrowing the draw-way which has now a least available width of about 38 feet. The sheathing on the sides of the draw-way is also in bad condition and insufficient.

The abutments and superstructure of this part of the bridge are in good condition, and apparently require only ordinary repairs.

The fourth bridge is "Rocks Bridge," so called, between Haverhill and West Newbury. This bridge has four fixed spans and a draw-span, which are supported by two abutments and four piers. The piers are built of dimension granite resting on timber cribs filled with stone. The masonry of the piers is in generally good condition; but the timber of the cribs is considerably worn and broken, and in its present state liable to be damaged by ice, although it may stand some years without material injury, depending on the character of the winter and the manner in which the ice breaks up in the spring.

The superstructure of this bridge is somewhat out of repair in places; the trusses are bent or buckled, and not capable of sustaining as much weight as they should; but with moderate repairs and ordinary travel it may last for a number of years. The draw-span is a common leaf-draw, with a least width of 31.8 feet, in good repair, and is situated at the easterly end of the first span on the Haverhill side of the river, and on the westerly side of the channel. The flood-tide sets diagonally across the draw-way so that vessels are carried against the pier on the westerly side of the opening. Their passage through the draw-way might be facilitated, however, by draw-piers on either side of the bridge on the westerly side of the draw-way.

If the draw-way is widened, it should be located in the span next east of the present site, which would be nearer the centre of the river and current, and have an equal depth of water.

Groveland Bridge is the next in order, and is now in process of rebuilding. It is proposed to locate the draw-way in the middle of the channel, and to have it about sixty feet wide. When this bridge is complete it will be one of the best structures on the river. No other changes of plan are

necessary for further facility to navigation than already provided.

The draws in some of the bridges above referred to have been reported by parties, more particularly interested in steamboat-navigation, as not being of sufficient height above the level of the water to enable certain classes of steamboats to pass freely under them, which is considered a desirable facility of navigation, and it certainly is so where it can be practicably effected. But when a bridge is provided with a suitable draw which can be opened readily for the passage of all vessels which cannot pass under it, it seems like imposing a double burden to require a height of structure which would involve undue expense, or which would be out of proportion or adjustment, so to speak, with the approaches to and character of the respective shores of the river between which it crosses.

The relative burden upon the respective cities and towns in whose jurisdiction these bridges belong, of the expense of keeping them in repair and from time to time adapting them to improved and progressive modes of navigation, as compared with the importance and value to commerce and the public of the repairs and improvements requisite, is the problem to be solved in determining the improvements to be made. While the facilities afforded by these bridges of communication between the cities and towns bordering upon and near the river may have a beneficial public influence extending beyond their immediate locality, they have not the capacity nor the function of the waters of the river as a medium of communication and transportation which is almost limitless in its range and power. One instance of its value in this respect is the conveyance in one steamboat, in one summer season only, of thirty thousand persons from interior localities to the sea-beach for health and recreation.

The value of commercial transportation has also been recognized by the General Government in the liberal appropriations made and the laborious work done to improve the navigation of the river, the efficiency and even *possibility* of which is gauged by the capacity of the passage-ways through the bridges which cross its channels. These channels were a *first right of way*; and no restriction or interference with this right should be permitted or continued which is not of equivalent public value and advantage.

In view of the facts and circumstances which the Board have been able to ascertain in relation to the subject referred to them for investigation, they submit the following conclusions : —

First, The draw-way opening and draw in the part of the “Chain Bridge” between Deer Island and the Salisbury shore should be rebuilt and widened so as to give a clear passage-way of not less than fifty feet. In making the necessary alterations to effect this change, the lower members of the draw should be made as high above the water-level of the river as can be practicably accomplished without involving too radical a change in other features of the bridge. Suitable draw-piers should be built on either side of the bridge, and other modern appliances provided for the safe and convenient passage of vessels through the draw-way.

Second, The draw-way and draw in “Rocks Bridge” should be rebuilt at least fifty feet wide, and located in the span next east of the one in which it now is. The lower members of the draw should also be made as high as practicable above the water-level of the river. Suitable draw-piers and other appliances should be provided as for the other bridge.

Third, The draw pier between and connecting the city and railroad bridges at Newburyport should be completed, and such changes made in its alignment as will best secure the safe and convenient passage of vessels through these two bridges, which must be done by one operation while both of the draws are open.

VINEYARD HAVEN HARBOR.

At the request of citizens of Vineyard Haven, and after the conclusion by the Board of its expediency, a re-survey of portions of the harbor was made by the engineer during the last summer as a means of comparison with former observations, and to show what changes, if any, had taken place in the harbor. The results did not show the changes which local observers had anticipated in the general condition of the harbor. The anxiety manifested, however, by those continually observing it, is but the renewal of the subject of its value and the importance of some adequate means for the protection of the thousands of vessels which seek its anchorage grounds. This matter in the logic of events must sooner

or later receive the practical attention of the General Government. We need hardly reiterate the fact that the geographical position and peculiar surroundings of this harbor make it one of the most remarkable roadsteads, not only within the limits of this Commonwealth but in the whole range of the Atlantic coast of the United States. Its proximity to the pathway of the immense coastwise fleet which night and day continually pass its headlands, its accessibility in all winds and weather, and being at the threshold, as it were, of the dangerous region of fog and shoals which characterize the navigation around Cape Cod, make its value as a refuge almost beyond estimate. It is excellent in all the conditions of a roadstead save one, — that of exposure to the north-east. The correction of this defect, which is a practicable one, is the improvement and protection needed to make it one of the most useful harbors of the world.

BOUNDARY-LINES BETWEEN CITIES AND TOWNS BORDERING UPON THE SEA.

By chap. 196 of the Acts of 1881 the Board was directed to locate and define the courses of the boundary-lines between adjacent cities and towns bordering upon the sea, and upon arms of the sea, from high-water mark outward to the line of the Commonwealth as defined by sect. 1 of chap. 1 of the Revised Statutes; and to file a report of their doings, with suitable plans and exhibits, showing the boundary-lines of any town by them located and defined, in certain specified places.

So much of sect. 1 chap. 1 of the Revised Statutes, as refers to the extension of the boundary-lines between cities and towns bordering upon the sea, to the line of the Commonwealth, is as follows: "The territorial limits of this Commonwealth extend one marine league from its seashore at low-water mark. When an inlet or arm of the sea does not exceed two marine leagues in width, between headlands, a straight line from one headland to the other is equivalent to the shore-line."

It was quite impracticable for the Board to make original surveys, or prepare original plans upon which to show the lines to be located and defined, according to the act directing that work to be done; and no survey of limited scope

or means which they could make would have been so well adapted to the purposes required as the elaborate and accurate ones of the United States Coast and Geodetic Survey. The system upon which these maps are made affords the particular data desired in locating and describing the initial points in the line of State jurisdiction, which it is important to define in order to locate the points of intersection with it, or the termination at it of the boundary-lines between respective cities and towns. The details of coast topography upon these government maps also afford data for determining the points upon the shore where boundary-lines on land terminate. The maps selected are classed and entitled "Coast Charts Nos. 11, 12, and 13, coast of the United States," "Coast Charts Nos. 9 and 10, Massachusetts Bay," and "Coast Chart No. 8, from Wells to Cape Ann." The first three in one sheet include the line of the Commonwealth from the boundary with Rhode Island to Chatham on Cape Cod, the second two in one sheet the line of the Commonwealth from Chatham to the Dry Salvages on Cape Ann, and the third from the Dry Salvages to the boundary with New Hampshire.

The Board has found the duty imposed upon them one of peculiar interest; and, so far as they are aware, it is the first instance of such action being taken, and such illustrated determination of the limits of territorial jurisdiction being made, by any State bordering upon the sea. The work has proved to be more exacting than at first supposed, and will require more time and means to complete than was originally estimated. In examining the records, markings, and geographical peculiarities of the various terminal points of the boundary-lines between cities and towns upon the shore, it has been found necessary to visit the locality of nearly every terminal point so far considered, in order to ascertain the nature and particulars of each, whether on land and marked by monument, or whether in the mouth of some channel, bay, or creek. These have been conditions and facts necessary to determine, before the study of the extension of any given boundary-line to the line of the Commonwealth could be made and projected upon the plan. In some cases the Board has found difficulty in determining these bases for locating and defining the courses of respec-

tive boundary-lines. Two cases, those between Provincetown and Truro, and between Sandwich and Wareham, have presented questions of so much import as to require public hearings, and, in the case of Sandwich and Wareham, the action of learned counsel on either side. In this latter case the Board has held hearings at the location of the line, and in the office of the Board at Boston.

It has been found impracticable, within the past appropriate season, to do more than examine the series of boundary-lines between the towns in the peninsular portion of Cape Cod, from and including the boundary-line before mentioned, between Sandwich and Wareham, and Provincetown at the east and Gosnold at the west end of the Cape. The Board has projected, upon the maps referred to, the line of the Commonwealth. The position of the initial points, or points of deflection, in this line of the Commonwealth, are plotted to single seconds of latitude and longitude, which is as near as the scale of the maps will accurately exhibit. These positions can be reproduced upon any map of the Coast Survey, of any scale, and can be found upon the ground or water, by instrumental observation, by any competent engineer or surveyor. The limit of error or indefiniteness in the exact position of each point will not exceed a mean difference of about twenty-seven metres, equal to about twenty-nine yards. When it is considered that these points represent positions on the ocean, not less than three marine leagues from the nearest land, this location of a point is sufficiently represented for all practicable purposes. The maps on which the line is plotted are based upon a polyconic projection on a scale of $\frac{1}{80000}$, whereon each fifth minute of latitude and longitude is drawn.

LINE OF THE COMMONWEALTH.

The line of the Commonwealth begins at a point marked A on plan No. 3, which is comprised of the United States Coast and Geodetic Survey "Coast Charts Nos. 11, 12, and 13," in lat. $41^{\circ} 25' 05''$, long. $71^{\circ} 05' 28''$, distant one marine league from the shore-line, which is a line from the headland at Warren's Point in Rhode Island to the headland at Gooseberry Neck in Massachusetts, and runs easterly, parallel to the last-named line, to a point marked B on plan, in lat. $41^{\circ} 25' 25''$, long. $71^{\circ} 03' 16''$.

Thence south-easterly, parallel to and distant one marine league from a line from the said headland at Gooseberry Neck to the headland at the south-westerly point of the island of Cuttyhunk, to a point marked C on plan, in lat. $41^{\circ} 22' 23''$, long. $70^{\circ} 59' 33''$.

Thence south-easterly, on the arc of a circle of one marine league radius, from the said headland at Cuttyhunk to a point marked D on plan, in lat. $41^{\circ} 21' 55''$, long. $70^{\circ} 58' 50''$.

Thence south-easterly, parallel to and distant one marine league from a line from said headland at Cuttyhunk to the headland at the north-westerly point of Gay Head on the island of Martha's Vineyard, to a point marked E on plan, in lat. $41^{\circ} 19' 30''$, long. $70^{\circ} 53' 55''$.

Thence southerly, parallel to and distant one marine league from a line from the said headland at Gay Head to the headland at the westerly point of the island of No Man's Land, to a point marked F on plan, in lat. $41^{\circ} 15' 17''$, long. $70^{\circ} 53' 32''$.

Thence south-easterly, easterly, and north-easterly, on a curved line parallel to and distant one marine league from the general curve of the southerly shore-line of said No Man's Land, to a point marked G on plan, in lat. $41^{\circ} 13' 32''$, long. $70^{\circ} 44' 15''$.

Thence north-easterly, parallel to and distant one marine league from a line from the south-easterly headland of said No Man's Land to the south-easterly headland of Squipnocket on said Martha's Vineyard, to a point marked H on plan, in lat. $41^{\circ} 16' 18''$, long. $70^{\circ} 42' 26''$.

Thence north-easterly, parallel to and distant one marine league from a line from said headland at Squipnocket to the headland at the easterly end of Nashaquitsa Cliff on said Martha's Vineyard, to a point, marked I on plan, in lat. $41^{\circ} 17' 25''$, long. $70^{\circ} 40' 48''$.

Thence easterly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line of said Martha's Vineyard, to a point marked K on plan, in lat. $41^{\circ} 17' 45''$, long. $70^{\circ} 35' 30''$.

Thence easterly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line on said Martha's Vineyard, to a point marked L on plan, in lat. $41^{\circ} 17' 35''$, long. $70^{\circ} 26' 43''$.

Thence easterly, a little southerly, parallel to and distant one marine league from a line from the south-easterly headland of the island of Chappaquiddick to the headland at the south-easterly point of the island of Muskeget, to a point marked L¹, in lat. $41^{\circ} 16' 34''$, long. $70^{\circ} 21' 30''$.

Thence south-easterly, on the arc of a circle of one marine league radius from the southerly Sand Island between the said island of Muskeget and the island of Tuckernuck, to a point marked M on plan, in lat. $41^{\circ} 15' 46''$, long. $70^{\circ} 20' 10''$.

Thence south-easterly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line of the southerly shore of the island of Nantucket, to a point marked M¹ on plan, in lat. $41^{\circ} 11' 20''$, long. $70^{\circ} 06' 55''$.

Thence easterly, parallel to and distant one marine league from a line from the headland opposite Miacomet Pond to Tom Never's Head on said Nantucket, to a point marked M² on plan, in lat. $41^{\circ} 11' 06''$, long. $70^{\circ} 00' 30''$.

Thence easterly and some northerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line of said Nantucket, to a point south-east of the south-easterly headland at Siasconsett, marked M³ on plan, in lat. $41^{\circ} 12' 30''$, long. $69^{\circ} 55' 15''$.

Thence north-easterly and northerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line of said Nantucket, to a point east of the light-house at Sankaty Head, marked M⁴ on plan, in lat. $41^{\circ} 16' 55''$, long. $69^{\circ} 53' 15''$.

Thence north-westerly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line of said Nantucket, to a point north-easterly from the northerly headland at Great Point, marked M⁵ on plan, in lat. $41^{\circ} 25' 55''$, long. $69^{\circ} 59' 55''$.

Thence north-westerly, westerly, and south-westerly, on the arc of a circle of one marine league radius from said headland at Great Point, to a point marked M⁶ on plan, in lat. $41^{\circ} 24' 26''$, long. $70^{\circ} 06' 27''$.

Thence southerly and some westerly, parallel to and distant one marine league from a line from said headland at Great Point to the headland at the south-westerly point of

Coatuc Beach, to a point marked M⁷ on plan, in lat. $41^{\circ} 20' 39''$, long. $70^{\circ} 07' 47''$.

Thence westerly, parallel to and distant one marine league from a line from said headland at Coatuc Beach to the headland opposite the north-easterly cove of Matacut Harbor, to a point marked M⁸ on plan, in lat. $41^{\circ} 20' 38''$, long. $70^{\circ} 10' 10''$.

Thence north-easterly, parallel to and distant one marine league from the line from said headland near Matacut Harbor to the headland at the easterly point of Muskeget Island, to a point marked M⁹ on plan, in lat. $41^{\circ} 22' 44''$, long. $70^{\circ} 15' 24''$.

Thence westerly and southerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line of the northerly side of said Muskeget Island, to a point marked M¹⁰ on plan, in lat. $41^{\circ} 23' 15''$, long. $70^{\circ} 19' 15''$.

Thence north-westerly, parallel to and distant one marine league from a line from the headland at the north-westerly point of said Muskeget Island to the headland opposite the south-easterly cove of Cape Poge Bay on the said Chappaquiddick Island, to a point marked N on plan, in lat. $41^{\circ} 24' 40''$, long. $70^{\circ} 22' 32''$.

Thence northerly and north-westerly, partly on a curved line and partly on the arc of a circle distant one marine league and radius one marine league from the shore-line and headland at the north-easterly point of said Cape Poge, to a point marked O on plan, in lat. $41^{\circ} 27' 53''$, long. $70^{\circ} 24' 35''$.

Thence north-westerly, parallel to and distant one marine league from a line from said headland at Cape Poge to the headland at the northerly point of the East Chop of Vineyard Haven, on said Martha's Vineyard, to a point marked P on plan, in lat. $41^{\circ} 29' 11''$, long. $70^{\circ} 27' 38''$.

Thence north-easterly, parallel to and distant one marine league from a line from said headland at East Chop to the headland between Waquoit and Popponessett Bays on the main shore, to a point marked Q on plan, in lat. $41^{\circ} 30' 53''$, long. $70^{\circ} 25' 55''$.

Thence north-easterly, parallel to and distant one marine league from a line from said last-named headland to the

headland opposite the south-easterly cove of Oysterville Harbor, to a point marked R on plan, in lat. $41^{\circ} 33' 23''$, long. $70^{\circ} 21' 34''$.

Thence easterly, parallel to and distant one marine league from a line from the said headland at Oysterville to the headland at Point Gammon, to a point marked S on plan, in lat. $41^{\circ} 33' 18''$, long. $70^{\circ} 15' 35$.

Thence easterly, on the arc of a circle of one marine league radius from said headland at Point Gammon, to a point marked T on plan, in lat. $41^{\circ} 33' 31'$, long. $70^{\circ} 14' 11''$.

Thence north-easterly, parallel to and distant one marine league from a line from said headland at Point Gammon to the headland on the east side of Swan Pond River, to a point marked U on plan, in lat. $41^{\circ} 36' 01''$, long. $70^{\circ} 06' 55''$.

Thence north-easterly, parallel to and distant one marine league from a line from said headland near Swan Pond River to the headland near Red River, to a point marked V on plan, in lat. $41^{\circ} 36' 30''$, long. $70^{\circ} 03' 45''$.

Thence southerly, parallel to and distant one marine league from a line from the headland at Inward Point on Monomay Island to the headland at the southerly point of said Monomay Island, to a point marked W on plan, in lat. $41^{\circ} 33' 07''$, long. $70^{\circ} 04' 30''$.

Thence southerly, south-easterly, and easterly, on the arc of a circle of one marine league radius from said headland at Monomay to a point marked W on plan, in lat. $41^{\circ} 30' 12''$, long. $69^{\circ} 58' 05''$.

Thence north-easterly, on a curved line parallel to and one marine league distant from the general curve of the shoreline of Monomay Island, to a point marked X on plan, in lat. $41^{\circ} 32' 17''$, long. $69^{\circ} 55' 21''$.

Thence northerly, a little easterly, parallel to and distant one marine league from the line from the headland near Monomay Light-house to the headland opposite Rump Hole on said Monomay Island, to a point marked Y on plan, in lat. $41^{\circ} 36' 42''$, long. $69^{\circ} 52' 58''$.

Thence north, a little easterly, parallel to and distant one marine league from a line from the said headland near Rump Hole to the headland opposite Morris Island, to a point marked Y¹ on plan, in lat. $41^{\circ} 38' 06''$, long. $69^{\circ} 52' 20''$.

Thence northerly, a little easterly, parallel to and distant

one marine league from a line from the said headland near Morris Island to the headland near Allen's Point on Nausett Beach, to a point marked Z on plan, in lat. $41^{\circ} 42' 31''$, long. $69^{\circ} 51' 05''$.

Thence northerly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked A² on plan, which is identical with the point marked A on plan No. 2 comprised of the United States Coast and Geodetic Survey "Coast Charts No. 9 and 10," in lat. $41^{\circ} 49' 02''$, long. $69^{\circ} 51' 55''$.

Thence north, a little easterly, on a slightly curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked B on said plan No. 2, in lat. $41^{\circ} 53' 40''$, long. $69^{\circ} 53' 12''$.

Thence north, a little westerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked B¹ on plan, in lat. $41^{\circ} 59' 18''$, long. $69^{\circ} 55' 50''$.

Thence north, more westerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked C on plan, in lat. $42^{\circ} 04' 33''$, long. $70^{\circ} 00' 20''$.

Thence north-westerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked C¹ on plan, in lat. $42^{\circ} 07' 32''$, long. $70^{\circ} 08' 00''$.

Thence westerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked D on plan, in lat. $42^{\circ} 07' 34''$, long. $70^{\circ} 14' 15''$.

Thence south-westerly and southerly, on a curved line parallel to and distant one marine league from the general curve of the shore-line, to a point marked D¹ on plan, in lat. $42^{\circ} 03' 42''$, long. $70^{\circ} 18' 22''$.

Thence south-easterly, partly on a curved and partly on a straight line parallel to and distant one marine league from the general curve and trend of the shore-line, to a point marked E on plan, in lat. $41^{\circ} 58' 57''$, long. $70^{\circ} 14' 01''$.

Thence south-easterly, parallel to and distant one marine league from a line from the headland at Wood End to the headland at Boundbrook Island, to a point marked F on plan, in lat. $41^{\circ} 55' 01''$, long. $70^{\circ} 08' 27''$.

Thence southerly, parallel to and distant one marine league from a line from the said headland at Boundbrook Island to the headland at the southerly end of Great Beach Hill, to a point marked G on plan, in lat. $41^{\circ} 53' 10''$, long. $70^{\circ} 08' 26''$.

Thence southerly, parallel to and distant one marine league from a line from said headland at Great Beach Hill to the headland at Billingsgate Island, to a point marked H on plan, in lat. $41^{\circ} 51' 40''$, long. $70^{\circ} 08' 08''$.

Thence southerly, parallel to and distant one marine league from a line from said headland at Billingsgate Island to the headland near the village of Brewster, to a point marked I on plan, in lat. $41^{\circ} 48' 38''$, long. $70^{\circ} 08' 39''$.

Thence westerly, a little southerly, parallel to and distant one marine league from a line from said headland near Brewster to the headland on Beach Point, to a point marked K on plan, in lat. $41^{\circ} 47' 18''$, long. $70^{\circ} 16' 38''$.

Thence westerly, parallel to and distant one marine league from a line from said headland at Beach Point to the headland near Scorton Neck, to a point marked L on plan, in lat. $41^{\circ} 47' 31''$, long. $70^{\circ} 22' 54''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland near Scorton Neck, to the headland at Scusset Beach, to a point marked M on plan, in lat. $41^{\circ} 49' 26''$, long. $70^{\circ} 27' 03''$.

Thence northerly, parallel to and distant one marine league from a line from the said headland at Scusset Beach to the headland at Centre Hill Point, to a point marked N on plan, in lat. $41^{\circ} 51' 50''$, long. $70^{\circ} 27' 08''$.

Thence northerly, a little westerly, parallel to and distant one marine league from a line from the said headland at Centre Hill Point to the headland at Manomet Point, to a point marked O on plan, in lat. $41^{\circ} 56' 09''$, long. $70^{\circ} 27' 56''$.

Thence south-westerly, on the arc of a circle of one marine league radius from said headland at Manomet Point, to a point marked P on plan, in lat. $41^{\circ} 57' 10''$, long. $70^{\circ} 28' 23''$.

Thence north-westerly, parallel to and distant one marine league from a line from said headland at Manomet Point to the headland at Gurnet Point, to a point marked Q on plan, in lat. $42^{\circ} 01' 40''$, long. $70^{\circ} 31' 59''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland at Gurnet Point

to the headland at Brant Rocks, to a point marked R on plan, in lat. $42^{\circ} 06' 34''$, long. $70^{\circ} 34' 23''$.

Thence north-easterly, on the arc of a circle of one marine league radius from said headland at Brant Rocks, to a point marked S on plan, in lat. $42^{\circ} 07' 17''$, long. $70^{\circ} 34' 53''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland at Brant Rocks to the headland near North River, to a point marked T on plan, in lat. $42^{\circ} 10' 00''$, long. $70^{\circ} 37' 35''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland near North River to the headland at Scituate Harbor, to a point marked U on plan, in lat. $42^{\circ} 13' 26''$, long. $70^{\circ} 38' 53''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland at Scituate Harbor to the headland at Minot's Ledge, to a point marked V on plan, in lat. $42^{\circ} 17' 32''$, long. $70^{\circ} 41' 38''$.

Thence north-westerly, on the arc of a circle of one marine league radius from the said headland at Minot's Ledge, to a point marked W on plan, in lat. $42^{\circ} 18' 53''$, long. $70^{\circ} 43' 33''$.

Thence north, more westerly, parallel to and distant one marine league from a line from the said headland at Minot's Ledge to the headland at Point Allerton, to a point marked X on plan, in lat. $42^{\circ} 20' 20''$, long. $70^{\circ} 48' 00''$.

Thence north, a little easterly, parallel to and distant one marine league from a line from the said headland at Point Allerton to the headland at the North-east Graves, to a point marked Y on plan, in lat. $42^{\circ} 21' 46''$, long. $70^{\circ} 47' 38''$.

Thence north, a little easterly, parallel to and distant one marine league from a line from the said headland at North-east Graves to the headland at Great Pig Rocks, to a point marked Z on plan, in lat. $42^{\circ} 26' 20''$, long. $70^{\circ} 46' 58''$.

Thence north-easterly, parallel to and distant one marine league from a line from the said headland at Great Pig Rocks to the headland at Inner Breaker, to a point marked Z¹ on plan, in lat. $42^{\circ} 29' 00''$, long. $70^{\circ} 43' 22''$.

Thence north-easterly, parallel to and distant one marine league from a line from the said headland at Inner Breaker to the headland at Eastern Point, to a point marked Z² on plan, in lat. $42^{\circ} 32' 18''$, long. $70^{\circ} 36' 59''$.

Thence north-easterly, on a slightly curved line parallel

to and distant one marine league from the general curve of the southerly shore-line of Eastern Point, to a point marked Z^3 on plan, in lat. $42^\circ 32' 37''$, long. $70^\circ 36' 17''$.

Thence north-easterly, parallel to and distant one marine league from a line from the headland on the southerly shore of Eastern Point to the headland at Londoner, to a point marked Z^4 on plan, in lat. $42^\circ 35' 45''$, long. $70^\circ 31' 00''$.

Thence north-easterly and northerly, on the arc of a circle of one marine league radius from the said headland at Londoner, to a point marked Z^5 on plan, in lat. $42^\circ 38' 06''$, long. $70^\circ 29' 34''$.

Thence northerly, parallel to and distant one marine league from a line from the said headland at Londoner to the headland at Dry Salvages, to a point marked Z^6 on plan, in lat. $42^\circ 40' 26''$, long. $70^\circ 29' 40''$.

Thence northerly and north-westerly, on the arc of a circle of one marine league radius from said headland at Dry Salvages, to a point marked Z^7 on plan, which is identical with a point marked A on plan No. 1 comprised of the United States Coast Survey "Chart No. 8 from Wells to Cape Ann," in lat. $42^\circ 43' 04''$, long. $70^\circ 32' 09''$.

Thence north-westerly, parallel to and distant one marine league from a line from the said headland at Dry Salvages to the headland at Halibut Point, marked B on said plan No. 1, in lat. $42^\circ 44' 15''$, long. $70^\circ 35' 53''$.

Thence westerly, on the arc of a circle of one marine league radius from the said headland at Halibut Point, to a point marked C on plan, in lat. $42^\circ 44' 25''$, long. $70^\circ 38' 30''$.

Thence westerly, a little northerly, parallel to and distant one marine league from a line from a headland near the said Halibut Point to the headland at the southerly end of Plum Island, to a point marked D on plan, in lat. $42^\circ 45' 02''$, long. $70^\circ 42' 43''$.

Thence northerly, a little westerly, parallel to and distant one marine league from a line from the said headland at the southerly end of Plum Island to the headland near the mouth of Merrimack River, to a point marked E on plan, in lat. $42^\circ 48' 25''$, long. $70^\circ 43' 52''$.

Thence northerly, a little easterly, parallel to and distant one marine league from the said headland near the mouth of Merrimack River to the headland at Old Cellar Rock, to a

point marked F on plan, the northerly terminus of the line, in lat. $42^{\circ} 51' 55''$, long. $70^{\circ} 43' 26''$.

The linear extent of the line of the Commonwealth, in its course as above defined, around the islands of Martha's Vineyard and Nantucket, and around Cape Cod and Cape Ann from the point of boundary with the State of Rhode Island to the south-easterly point of Nantucket, is about 75 miles; to the southerly point of Monomay, about 158 miles; to the northerly point of Cape Cod at Race Point, about 222 miles; to the entrance of Boston Harbor, about 304 miles; to the easterly point of Cape Ann, about 336 miles; and to the northerly terminus of the line of the Commonwealth at its boundary with New Hampshire, about 355 miles.

The distance from the southerly terminus of the line of the Commonwealth at its boundary with Rhode Island to the southerly point of Monomay following the line of the Commonwealth and the line of boundary between the towns bordering on Vineyard Sound, is about 71 miles.

HARBOR IMPROVEMENTS BY THE GENERAL GOVERNMENT.

Boston Harbor.

The works of the General Government in the harbors of the State during the past year have been continued with increasing advantages to its commerce. The opportunities which the Board have had to observe the character and progress of this work make it gratifying as well as incumbent upon them to call attention to the long and interested service which the engineer officers of the United States in charge of it have rendered to the Commonwealth, and the value of their personal and professional experience in examinations and estimates, and in the execution of the varied and difficult projects of improvement submitted to their care. The Board is indebted to both Gen. Thom and Gen. Warren for the continued courtesy of information concerning their respective works.

In the northern division of the seacoast of the State, in charge of Gen. George Thom, United States engineer, the work done in Boston Harbor has been the important one of removing "Anchorage Shoal," in the main basin of the upper

harbor. 47,224 cubic yards have been dredged, which has added 225 feet to the width of the main channel, the aggregate of which is now about 770 feet. By the early part of March the width will be still further increased to about 810 feet, and by the end of next November the full projected width of the channel will be effected. The Board hope, however, that the development of the harbor has reached a point which will induce the General Government to revise its project for the improvement of the main channel so as to increase materially the minimum width heretofore contemplated.

In execution of the project for the improvement of Charles River, from its mouth to the dam at the head of tide-water at Watertown, 63,000 cubic yards of dredging has been done, and the improvement of the channel completed, from the mouth of the river to Western-avenue Bridge, a distance of about $4\frac{3}{4}$ miles.

At the mouth of the Mystic River 48,343 cubic yards of dredging has been done, which has increased the width of the channel by 125 feet, making its total average width 250 feet. Still further work of excavation has been begun, to be completed the coming season, which will complete the project of improvement for this river.

Repairs have been made, where most necessary, on the sea-walls of Lovell's Island, Long Island, and Deer Island.

21,924 cubic yards of dredging has been done in Nantasket Beach channel, which has opened the channel to a width of about 70 feet, and a depth at mean low water of $9\frac{1}{2}$ feet.

In order to complete all the works now projected for the improvement of Boston Harbor, the following appropriations have been asked for: to wit,—

Widening main ship channel at Upper Middle, at its westerly end, and for rebuilding and repairing sea-walls in Boston Harbor proper		\$24,000
Completing improvement of Charles River		67,500
Completing channel leading to Nantasket Beach		5,000
		<hr/>
		\$96,500

Merrimack River.

The improvement of the Merrimack River is a work of much importance, particularly to the citizens of the north-eastern portion of the State. The increased facilities given to all

classes of navigation by the aid of the General Government, and the improvement of the draw-way openings through the various bridges, will give a character and value to the river not heretofore possessed. As stated by Gen. Thom, the object of the present project for the improvement of this river is to afford a channel of navigable width and a depth of not less than nine feet at mean low water from its mouth at the outlet of Newburyport Harbor up to Deer Island Bridge, — a distance of about five miles; and thence up to Haverhill Bridge, — an additional distance of $12\frac{1}{2}$ miles, with a depth of twelve feet at ordinary *high water*, the rise and fall of tides varying from seven and a half to four feet; and thence up to the head of the “Upper Falls,” — a distance of four miles, a depth of not less than four feet and a half in the ordinary stages of the river, with the mill-water at Lawrence running, the rise and fall of the tides varying from four feet at Haverhill to none at the foot of the “Upper Falls.”

The natural channel of this river was very narrow and crooked in several places, and much obstructed by sunken ledges, boulders, and shoals, and especially at the falls, portions of which were covered with boulders and ledges more or less bare, and impassable for any vessels or scows; whilst in Newburyport Harbor the channel was obstructed by numerous sunken ledges, crib-work piers, and wrecks, seriously endangering navigation. Previous to January, 1881, the work done for the improvement of this river consisted in opening the channel above Haverhill and through the falls to the projected width and depth in places where absolutely necessary to make its navigation practicable, also in dredging at Haverhill between the bridges, and at Silsby Island shoals, as well as at Currier's shoal, about four miles below Haverhill, including the removal of a large number of dangerous sunken rocks at and near Rocks Bridge and the head of Silsby Island; also in Newburyport Harbor in the removal of “Ganway Rock” and “North Rocks” in part, and in the removal of two sunken wrecks. During the past year the removal of “South Ganway Rock” in Newburyport Harbor to a depth of nine feet at mean low water has been completed, together with the breaking up and removal of North Rock spur to a depth of nine feet, and the breaking up and removal of South Badger ledge near the mouth of the river to ten feet at mean low water.

Newburyport Harbor.

The project of improvement for Newburyport Harbor was to afford a permanent channel through the outer bar, with a depth sufficient to allow vessels of $13\frac{1}{2}$ feet draught to cross it at mean low water, the rise and fall of the tides being $7\frac{1}{2}$ feet. To effect this, the project of two converging rubble-stone jetties has been adopted, to be built out from the shore at points north and south of the entrance to a height of four feet above mean high water, with a width of 15 feet on top, with inner slope of 45° , and outer slope of $22\frac{1}{2}^\circ$, the entrance through the outer extremities of the jetties to be 1,000 feet in width. The cost of these jetties is estimated at \$365,000. Work has already been done on the northern jetty by the placing of about 13,743 tons of stone, whereby the work has been built out for a distance of about 700 feet from Salisbury Beach.

Scituate Harbor.

A survey of Scituate Harbor was made by Gen. Thom in 1878, with a view to its adaptability as a harbor of refuge, and a project devised for two rubble-stone jetties to protect the entrance; also to excavate a basin inside of sufficient area for the harbor, with a depth of ten to twelve feet at mean low water, the greatest depth at present being not more than about five feet on a very small area; also to excavate a channel into the harbor, with a depth of not less than ten feet at mean low water. The estimated cost of this improvement as revised for the project adopted is \$280,000. \$17,500 of this amount has been appropriated, and during the last summer, after many interruptions caused by unfavorable weather, 5,088 tons of stone have been put in place.

Plymouth Harbor.

The existence of this harbor depends upon the protection and preservation of Long Beach, which has been under the care of the government engineers from 1864 to and including 1881, and \$84,800 in various sums have been appropriated for their work. In 1875 a channel was dredged fifty feet wide and six feet deep at mean low water, from the "middle ground" up to "Long Wharf," — a distance of about 2,500 feet. The project of improvement, however, provides for a

channel 100 feet wide up to Long Wharf, and extended southward towards the mouth of Town Brook,—a distance of about 900 feet above Long Wharf,—so as to form a basin in front of the wharves of the city 150 feet in width and eight feet deep at mean low water. On the 1st of September, 1881, this project was entirely completed by the removal of 103,505 cubic yards of material from the channel and basin referred to. It is most gratifying to state that the only work that now remains to be done for the preservation and protection of this harbor consists in the repairs of the works on Long Beach where necessary.

Provincetown Harbor.

All the works projected for the protection, preservation, and improvement of this harbor have been completed, with the exception of the bulkheads on Long Point, which are in good condition, and fully answer the purposes designed. They will, however, require continual watching and occasional repairs.

Lynn Harbor.

A survey of Lynn Harbor has been made, with a view to its improvement, and a project and estimate for the respective work has been submitted to the Chief of Engineers to be laid before Congress.

Merrimack River, from Lawrence, Mass., to Manchester, N.H.

A survey, project, and estimate of cost for this part of the river—a distance of about forty-eight miles and a half—have been made, and submitted to the Chief of Engineers, to be laid before Congress.

GOVERNMENT WORK IN CHARGE OF GEN. G. K. WARREN.

The works of harbor improvement upon the southern coast of the State in charge of Gen. G. K. Warren, United States Engineers, are of much importance, particularly those of protection and improvement of the harbors of refuge in the dangerous navigation of this part of the coast.

Nantucket Harbor.

Up to the 30th of June last, nearly 4,000 tons of granite had been placed in the jetty on the westerly side of the

entrance to Nantucket Harbor, extending it 850 feet, and additional work has been done upon it since. Gen. Warren considers it too soon to see or predict the effect of the jetty in increasing the depth of water over the shoals; but careful and comprehensive surveys have been made as a basis for future comparison of changes following the construction of the jetty. Seventy-five thousand dollars is asked for the completion of this work by June 30, 1883.

Edgartown Harbor.

During the last summer a conference was held at Edgartown between Gen. G. K. Warren, the chairman of this Board, and the citizens of the port interested in the harbor, to discuss and devise means for its improvement.

With a small unexpended portion of a former government appropriation, to which the Board added the sum of \$300, a re-survey was made under the direction of Gen. Warren in order to ascertain and compare the changes which have taken place in various parts of the harbor since the closing of the south beach in 1869. Gen. Warren has taken renewed interest in the problem of re-establishing a southern inlet to this harbor; and, while there are many difficulties and uncertainties attending its accomplishment, he considers the possibilities of success sufficient to warrant another appropriation by the General Government for the required work.

Woods Holl.

The work of improvement in this important thoroughfare executed during the fiscal year ending June 30, 1881, consisted in removing bowlders of various sizes, and completing the work which had been in progress during the previous year. The original plan and estimate for the thorough improvement of this passage-way comprehended extensive excavations at a cost of \$430,000. The demand for this, however, does not seem to be immediate. Gen. Warren says, "This complete improvement may truly be called a national one. It is not for the benefit of any special locality. It is for a navigable highway uniting two large bodies of navigable water extensively used by the commercial vessels of the United States; and when thoroughly improved it will

tend greatly to a saving of time, and diminish the dangers of general coast navigation.”

Taunton River.

Work has been executed for the improvement of Taunton River in conformity with previous plans and estimates, and a channel excavated eleven feet deep at mean high water, and from forty to sixty feet wide for a distance of 3,100 feet from the bridge at Weir down the river. An additional appropriation of \$25,000 has been made for continuing this improvement, and the amount estimated as necessary to complete the existing project to give an available depth of eleven feet at mean high water to Weir Bridge, is \$41,500.

Connecticut River.

The importance of the improvement of this river may be judged by the fact that after careful examination by the United States engineers, the amount estimated to complete existing projects is \$1,322,805. Satisfactory work has been done during the last year, and its continuance contemplated.

OFFICE AND FIELD WORK.

Plans approved and Licenses granted, during the Year 1881, for the Erection of Structures in and over Tide-Water.

Nos.

587. C. E. Stevenson, for leave to build a solid wharf on the south shore of Winthrop. Approved Jan. 13, 1881.
- 587½. Boston and Maine Railroad, for leave to rebuild its bridge across Merrimack River, between Bradford and Haverhill. Approved Jan. 20, 1881.
588. Killey E. Terry, for leave to construct a wharf on the west side of Clark's Cove, in the town of Dartmouth. Approved Jan. 20, 1881.
589. Old Colony Railroad Company, for leave to fill solid certain portions of its bridge on the line of its road across North River, in the towns of Marshfield and Scituate. Approved Jan. 20, 1881.
590. Hoosac Tunnel Dock and Elevator Company, for leave to extend its wharves (otherwise known as Damon's, Hittinger's, and Tudor's Wharves) on Charles River, Charlestown District. Approved Jan. 20, 1881.
591. Samuel Osborn, jun., and Walter S. Osborn, for leave to extend Osborn's Wharf, at Edgartown. Approved Feb. 3, 1881.
592. Boston and Albany Railroad Company, for leave to widen Pier No. 1, Grand Junction Wharves, East Boston. Approved Feb. 17, 1881.
593. P. E. Bowers, for leave to extend his wharf on Taunton River, in the town of Somerset. Approved Feb. 17, 1881.
594. The Boston Steamboat and Pier Company, for leave to construct a pile-pier on Cherry Island Bar, at Broad Sound Point, in the town of Revere. Approved March 17, 1881.
595. Moses Williams, for leave to straighten and widen the southerly side of India Wharf. Approved March 17, 1881.
596. City of Newburyport, for leave to construct a pile-structure for the purpose of giving greater safety to the first span in Newburyport Bridge. Approved March 25, 1881.
597. W. F. Whitney, for leave to extend his wharf on First Street, near F Street, South Boston. Approved March 31, 1881.
598. Hull and Nantasket Beach Railroad Company, for leave to construct a pile-wharf on the southerly side of Windmill Point, Hull. Approved March 31, 1881.
599. Forest Hill Company, for leave to build wharves and other structures on Taunton River, Fall River. Approved March 31, 1881.
600. Lyman R. Blake, for leave to construct a wharf on Charles Neck, town of Marion. Approved March 31, 1881.
601. J. H. and F. A. Langmaid, for leave to cover with a pile-structure part of their dock, Salem Harbor. Approved April 8, 1881.
602. O. F. Belcher, for leave to build a solid wharf on the south shore of Winthrop. Approved April 14, 1881.

44 HARBOR AND LAND COMMISSIONERS. [Jan.

Nos.

603. Chelsea Beach Railroad Company, for leave to build a bridge across an inlet from Pines River, in the town of Revere. Approved April 20, 1881.
604. Forest Hill Company, for leave to build a pile-wharf in front of its premises on the easterly side of Taunton River, city of Fall River. Approved April 21, 1881.
605. Eastern Railroad Company, for leave to fill flats in Frye's Mill-pond, Salem. Approved April 28, 1881.
606. City of Salem, for leave to build a canal with stone walls, in Frye's Mill-pond. Approved April 28, 1881.
607. Hoosac Tunnel Dock and Elevator Company, for leave to drive additional piles for the support of sheds upon Hittinger's Wharf, Charlestown District. Approved April 28, 1881.
608. William Pickering, jun., for leave to build a stone wall upon his wharf on Union Street, Salem. Approved April 28, 1881.
609. City of Boston, for leave to rebuild and extend its wharf on Deer Island, Boston Harbor. Approved May 5, 1881.
- 609^a. Central Wharf and Wet Dock Corporation, for leave to extend Central and India Wharves to the harbor line. Approved April 28, 1881.
610. Lyon, Depuy, and Co., for leave to rebuild and extend their wharf at East Boston. Approved May 19, 1881.
611. Hoosac Tunnel Dock and Elevator Company, for leave to extend its wharf, known as Gage's or Swett's Wharf, Charlestown District. Approved May 5, 1881.
612. Chelsea Beach Company, for leave to build a wharf at Pines Point, town of Revere. Approved May 26, 1881.
613. W. J. Humphrey, for leave to extend his wharf on Border Street, East Boston. Approved May 26, 1881.
614. Old Colony Railroad Company, for leave to extend its pile-wharf on Fort Point Channel, South Boston. Approved June 2, 1881.
615. Home for Aged Women, for leave to rebuild its sea-wall in front of its property bordering on Charles River, between Revere and Pinckney Streets. Approved June 16, 1881.
616. Eastern Railroad Company, for leave to widen and extend its wharf at East Boston. Approved June 3, 1881.
617. Edward P. Shaw, for leave to build a pile-pier on Merrimack River, near Salisbury Point. Approved June 13, 1881.
- 618 and 618^a. Chelsea Beach Railroad Company, for leave to construct a bridge across Pines River, in the towns of Revere and Saugus. Approved July 2, 1881.
619. Boston Forge Company, for leave to extend its wharf on Maverick Street, East Boston. Approved July 7, 1881.
620. Chelsea Beach Company, for leave to erect a group of bathing-houses near Pines Point. Approved July 14, 1881.
621. S. S. Swift of Provincetown, for leave to construct a pile-wharf in Provincetown Harbor. Approved July 21, 1881.
622. William Hayes, for leave to build a sea-wall and fill flats at Stage Point, Salem Harbor. Approved July 21, 1881.

Nos.

623. Boston Steamboat and Pier Company, for leave to extend its pier on Cherry Island Bar, at Broad Sound Point, in the town of Revere. Approved July 28, 1881.
624. Beacon Oil Company, for leave to extend its wharf on Chelsea Creek, East Boston. Approved July 28, 1881.
625. William Hale, for leave to extend his wharf on Merrimack River, City of Haverhill. Approved Aug. 4, 1881.
626. Hoosac Tunnel Dock and Elevator Company, for leave to drive additional piles upon Damon's Wharf, Charlestown District, for the support of sheds. Approved Aug. 11, 1881.
627. Alford Butler, for leave to build a wharf on Mill Creek, town of Revere. Approved Aug. 11, 1881.
628. William E. Gutterson, for leave to extend his wharf on Fort Point Channel. Approved Aug. 11, 1881.
629. Hoosac Tunnel Dock and Elevator Company, for leave to drive additional piles upon easterly Tudor Wharf, for the support of sheds, Charlestown District. Approved Sept. 22, 1881.
630. David L. and John G. Webster, for leave to build a wharf on Malden River, Malden. Approved Sept. 22, 1881.
631. R. W. Bowles, for leave to construct a wharf in Mattapoisett Harbor. Approved Sept. 22, 1881.
632. Board of Health of the town of Hull, for leave to construct a sewer outlet at Windmill Point, town of Hull. Approved Sept. 22, 1881.
633. Town of Malden, for leave to change the direction of Malden River, and also to construct a bridge across said river. Approved Sept. 29, 1881.
634. Boston and Maine Railroad, for leave to reconstruct its bridge across Merrimack River, between Bradford and Haverhill. Approved Sept. 29, 1881.
635. City of Boston, for leave to widen the passage-ways for vessels through Mount Washington Avenue Bridge, in Fort Point Channel. Approved Oct. 6, 1881.
- 635*. Trustees under the will of William S. Perry, for leave to extend Perry's Wharf, on Fort Point Channel, near Broadway Bridge. Approved Sept. 29, 1881.
636. Old Colony Railroad Company, for leave to extend its steamboat wharf, in the city of Fall River. Approved Oct. 13, 1881.
637. Nantasket Company, for leave to reconstruct its embankments along the line of high-water mark, on the inside or westerly shore of Nantasket Long Beach. Approved Oct. 15, 1881.
638. Proprietors of Rowe's Wharf, for leave to widen and extend their wharf to the harbor line, in Fort Point Channel. Approved Oct. 13, 1881.
639. Boston and Roxbury Mill Corporation, for leave to fill flats in Charles River, near the Beacon entrance of the Back Bay Park. Approved Nov. 10, 1881.
640. Thomas H. Balch, for leave to construct a pile-pier on Merrimack River, in the town of Groveland. Approved Oct. 27, 1881.

46 HARBOR AND LAND COMMISSIONERS. [Jan. '82.

- 641. Charles B. Barnes, for leave to extend his wharf, known as Humphrey's Wharf, Hingham Harbor. Approved Nov. 10, 1881.
- 642. N. P. Merriam, for leave to construct a pile-wharf near the foot of River Street, on Porter's River, Danversport. Approved Nov. 10, 1881.
- 643. John C. Tilton, for leave to extend his wharf on Merrimack Street, in the city of Haverhill. Approved Nov. 10, 1881.
- 644. Trustees under the will of Ebenezer Francis, for leave to extend Francis Wharf, on Fort Point Channel. Approved Nov. 28, 1881.
- 645. John S. Weeks, for leave to change a portion of his wharf from pile to solid, on Border Street, East Boston. Approved Dec. 1, 1881.
- 646. N. E. Harlow, for leave to extend his wharf in Plymouth Harbor. Approved Dec. 3, 1881.
- 647. Jabez K. Montgomery and Atwood L. Howard, lessees of the United States Government Wharf at Chelsea, for leave to drive piles in front of said wharf, in Chelsea Creek. Approved Dec. 8, 1881.
- 648. Samuel Haskell, for leave to extend his wharf in Gloucester Harbor. Approved Dec. 29, 1881.
- 649. Benj. F. Allen and Daniel Allen, jun., for leave to extend their wharf on Five Pound Island, Gloucester Harbor. Approved Dec. 29, 1881.
- 650. Charles Smiley, for leave to extend his wharf on Merrimack River, city of Haverhill. Approved Dec. 29, 1881.

Sixty-seven licenses have been granted, which is above the yearly average, though not as many as were issued in 1880. About one-third of the licenses granted were for structures in Boston Harbor. The Board has endeavored to make the inspection of localities where the erection of structures has been proposed, more thorough and systematic, and has found the demands upon its time and that of its employés to increase.

ALBERT MASON.
FRANCIS A. NYE.
HENRY L. WHITING.

BOSTON, Jan. 1, 1882.

APPENDIX.

APPENDIX.

[1.]

Articles of Agreement made this Twenty-first Day of June, in the Year Eighteen Hundred and Eighty-one, by and between F. G. WHITCOMB of East Boston in the County of Suffolk and Commonwealth of Massachusetts, Party of the First Part, and the COMMONWEALTH OF MASSACHUSETTS, acting by its Board of Harbor and Land Commissioners, Party of the Second Part, witness:—

The said party of the first part hereby covenants and agrees with said party of the second part to furnish all the materials, and build fourteen hundred (1,400) feet of bulkhead in three lines, as follows: one thousand (1,000) feet to be one hundred (100) feet east of and parallel to the easterly line of D Street, two hundred (200) feet to be two hundred and fifty (250) feet east of and parallel to the easterly line of C Street, and two hundred (200) feet to be one hundred (100) feet west of and parallel to the westerly line of C Street; each line to commence about two hundred and twenty (220) feet north-easterly of First Street, and run north-easterly.

The bulkhead is to be built of spruce piles driven six feet apart on centres, with a spurshore to each pile; and the piles are to be planked from the surface of the mud to grade seven (7).

The plan on file at the office of the Harbor and Land Commissioners shows the details and method of construction of the bulkhead, and is to be followed in details not otherwise mentioned.

The piles and spurshores shall be straight, and free from large knots, and not less than ten (10) inches diameter at the butt, and not less than six (6) inches diameter at the point when ready for driving. They are to be driven six (6) feet into the hard bottom, and all those injured by driving shall be removed and replaced by sound ones at the expense of the contractor.

The faces of the main piles must be brought to a true line before the planking is put on, the tops are to be cut off level at grade fourteen (14), and the spurshores are to be fitted at grade six and five-tenths (6.5); and each one will be bolted with one one-and-one-fourth-inch screw-bolt. The piles at the outer ends will be braced by two additional spurshores

fitted at grade ten (10), and bolted with one-and-one-fourth-inch screw-bolts.

The planks are to be spruce, three (3) inches thick, sound, sawed square, and not less than twelve (12) feet long. They are to be secured to the piles by wrought-iron ship-spikes six inches long, and three-eighths inch square, and the butt-joints must come on the piles.

If required by the engineer, the planks must be still farther secured, as shown in red on the afore-mentioned plan.

All the work to be done in a neat and workmanlike manner, in accordance with the lines, grades, and instructions given by the engineer, and to the satisfaction of the commissioners and the engineer.

The work to be commenced within two weeks, and to be prosecuted continuously till its completion.

The said party of the second part hereby covenants and agrees with said party of the first part to pay said party of the first part for said bulkhead at the rate of one dollar and fifty-two cents (\$1.52) per lineal foot, and, in case said extra fastening is required, at the rate of one dollar and sixty-nine cents (\$1.69) per lineal foot for the part where said extra fastening is required.

Monthly estimates of the work done will be made by the engineer, and payment of ninety per cent of the contract-price will be made thereon, the remaining ten per cent to be retained until the completion, final measurement, and acceptance of the work.

It is agreed by and between the parties hereto that upon all questions of measurement, lines, or grades, the decision of the engineer of said board shall be final.

In testimony whereof the said F. G. Whitcomb has hereunto set his hand and seal, and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by its Board of Harbor and Land Commissioners the day and year above written, and the same to be approved by its Governor and Council.

F. G. WHITCOMB.

[SEAL]

COMMONWEALTH OF MASSACHUSETTS,

[SEAL OF THE
COMMONWEALTH.]

By ALBERT MASON,
WILL'D P. PHILLIPS,
F. A. NYE.

IN COUNCIL, June 25, 1881.

Approved.

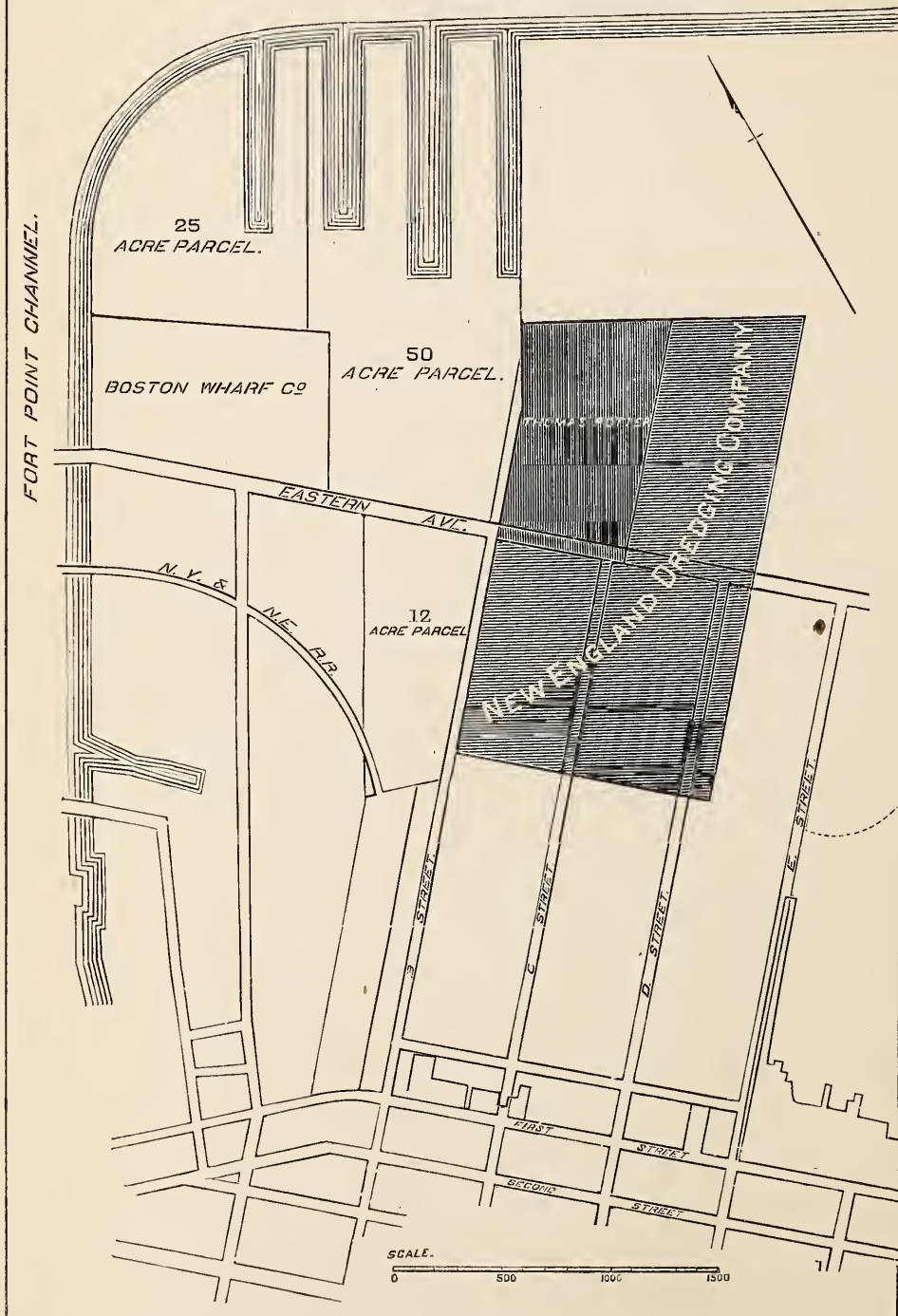
HENRY B. PEIRCE,

Secretary.



PLAN
SHOWING LOCATION OF FLATS.
TO BE FILLED UNDER CONTRACTS
TO ACCOMPANY REPORT FOR
1881.

MAIN SHIP CHANNL.



[2.]

Articles of Agreement made this Twelfth Day of August, in the Year Eighteen Hundred and Eighty-one, by and between the NEW ENGLAND DREDGING COMPANY, a Corporation duly established under the Laws of Massachusetts, Party of the First Part, and the COMMONWEALTH OF MASSACHUSETTS acting by its Board of Harbor and Land Commissioners, Party of the Second Part, witness:—

The said party of the first part hereby covenants and agrees with said party of the second part :

First, to dredge five hundred thousand cubic yards of material from the shoals in the harbor of Boston, lying southerly of the main ship channel and north-westerly of slate ledge, at places to be designated by the engineer of the Board of Harbor and Land Commissioners, and to deposit said dredged material on the flats of said Commonwealth lying between B Street and a line one hundred feet east of and parallel with the easterly line of D Street, and between the southerly line of Eastern Avenue and a line about one thousand feet south of and parallel with the southerly line of Eastern Avenue.

Second, to dredge four hundred thousand cubic yards of material from the shoals in the harbor of Boston lying southerly of the main ship channel and north-westerly of slate ledge, and deposit the same on the flats of the Commonwealth lying between a line fifty feet east of and parallel with the easterly line of C Street extended, and a line one hundred feet east of and parallel with the easterly line of D Street extended, and between the southerly line of Eastern Avenue and a line one thousand three hundred feet south of and parallel with the exterior line of South Boston Flats, as shown on the plan hereto annexed. All the dredging shall be to the depth of twenty-three feet at mean low water, except at the mouth of Fort Point Channel, where the bottom shall be sloped up to meet the bottom, as now dredged, and excepting in case of ledge and of bowlders of more than one-half of one cubic yard. All areas dredged over shall be left smooth and regular at the required depths. If any portion of said dredged area is excavated deeper than twenty-five feet at mean low water, an amount of material equal to the amount excavated below grade minus 25 shall, without expense to the Commonwealth, be excavated from and deposited by scows on such places on the flats as the engineer shall designate. The amount of the excavation will be determined by the measurement of the filling as hereinafter provided.

All the flats to be filled shall be filled from the present surface to grade 13, and at the completion of the work shall be left smooth and level at grade 13, where the boundaries of said filling are protected by other filling or by bulkheads. The filling shall be brought up to grade 13 at

such boundaries, but where the boundaries are unprotected the filling is to be allowed to take its natural slope.

In filling immediately behind a bulkhead, the filling must be deposited in such a manner that it will flow away from the bulkhead and not towards it.

In the work of both dredging and filling, the lines, grades, and instructions given by the engineer in charge must be strictly observed, and all necessary aid and material for giving said lines and grades shall be furnished by said party of the first part.

All the work shall be done to the reasonable satisfaction of the engineer at any time during the progress, and until the completion and acceptance, of the work.

The dredging and filling of the area first described shall be completed, and 175,000 cubic yards of the filling of the second described area shall be completed, within three years from the date of approval of this contract, and the whole 900,000 cubic yards shall be completed within four years from date of approval.

The work shall be commenced within a reasonable time, and prosecuted with the necessary vigor to insure its completion within the time herein stipulated.

The said party of the second part hereby covenants and agrees with said party of the first part to pay said party of the first part for excavating in the harbor, and filling the area described first, at the rate of fifty cents per cubic yard; and for excavating in the harbor, and filling the area described second, at the rate of forty-six cents per cubic yard; in the manner and upon the conditions herein set forth and agreed as follows: plans showing the present surface of the flats will be made by the engineer in charge before the filling is begun, and will be used as the basis of all measurements of filling. Monthly estimates of the work executed will be made by the engineer in charge, and payment will be made of seventy-five per cent of the contract price for all the material deposited below grade 5 and above grade 13, and ninety per cent of the contract price for all the material between grades 5 and 13.

When an area is graded level at grade 13, or at such grade as shall be thought necessary to allow for settling, payment will be made of ninety per cent of the contract price for all the material deposited on said area up to grade 13. The remaining ten per cent to be retained until the final completion and acceptance of the work.

When the area filled from one tramway has been levelled and maintained at grade 13 for one month, such area shall be accepted as to grade, and the contractor relieved of further care of the same.

It is agreed by and between the parties hereto, that upon all questions of measurement, lines or grades proposed in writing by one party and after notice to the other party, the decision of the engineer of said Board shall be final.

It is further agreed by and between the parties hereto, that should the party of the first part refuse or neglect to prosecute the work herein contracted for, with the requisite vigor to insure its completion within the time herein stipulated, or in any other respect make any substantial

violation of this agreement, the said Board shall have power to annul this agreement and to contract anew with other parties without prejudice to the claim of said party of the second part for damages arising from breach hereof.

The party of the second part further covenants and agrees with the party of the first part to build a bulkhead on the northerly and easterly boundaries of said areas to be filled, and also on the line between said areas and the area to be filled by Thomas Potter under his contract with the said Commonwealth dated Aug. 28, 1880.

In testimony whereof the said New England Dredging Company has caused its corporate seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by Charles H. Souther, its president and treasurer; and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by its Board of Harbor and Land Commissioners, the day and year above written, and the same to be approved by its Governor and Council.

NEW ENGLAND DREDGING COMPANY,

[NEW ENGLAND DREDG-
ING COMPANY SEAL,
1873.]

BY CHARLES H. SOUTHER,
Prest. & Treas.

Executed in presence of
D. KOPPMANN.

COMMONWEALTH OF MASSACHUSETTS,

[SEAL OF THE COMMON-
WEALTH OF MASSA-
CHUSETTS.]

BY ALBERT MASON,
FRANCIS A. NYE,
HENRY L. WHITING,
Harbor and Land Commissioners.

IN COUNCIL, Aug. 18, 1881.

Approved

HENRY B PEIRCE,
Secretary.

[3.]

Articles of Agreement made this Sixth Day of September, in the Year Eighteen Hundred and Eighty-One, by and between F. G. WHITCOMB of East Boston, in the County of Suffolk and Commonwealth of Massachusetts, Party of the First Part, and the COMMONWEALTH OF MASSACHUSETTS, acting by its Board of Harbor and Land Commissioners, Party of the Second Part, witness:—

The said party of the first part hereby covenants and agrees with said party of the second part, to furnish all the materials for and build about 4,000 feet of bulkhead on South Boston Flats, situated as follows: Beginning at the easterly line of B Street and southerly line of Eastern Avenue, running thence easterly along the southerly line of Eastern Avenue 600 feet, thence turning at right angles and running northerly 1,150 feet, thence turning and running easterly parallel to the exterior line of occupation of South Boston Flats, to a point 100 feet east of the easterly line of D Street extended, thence turning and running southerly parallel to and 100 feet east of the easterly line of D Street, about 2,280 feet, leaving a gap about 400 feet long in the most northerly line, and, if required, a gap in the most easterly line.

The bulkhead is to be built of spruce piles driven six feet apart on centres with two spurshores to each pile, and the piles planked from the surface of the mud to grade 13, and capped above the planks with a double girder cap each 6" × 12".

The plans in the office of the Harbor and Land Commissioners show the details and method of construction of the bulkhead, and are to be followed in all details not mentioned in this contract.

The piles and spurshores shall be straight and free from large knots, and not less than ten inches in diameter at the butt, and not less than six inches in diameter at the point when ready for driving. They are to be driven ten feet into the hard bottom, and all those injured by driving shall be removed and replaced by sound ones at the expense of the contractor.

The faces of the main piles must be brought to a true line before the planking is put on, the tops are to be cut off and capped at grade 14, and the spurshores are to be fitted one at grade 4, and the other at grade 12, and each one will be bolted with one 1½ inch screw-bolt. The end and corner piles are to be braced by four spurshores, instead of two, placed and fitted as directed by the engineer.

The caps are to be spruce, 6" × 12", and as long as possible, none being less than fifteen feet, and shall be fitted as shown on the plan bolted to the piles with one-inch screw-bolts, and the splices bolted with ¾ inch screw-bolts.

The planks are to be spruce, three inches thick, and in as long lengths as possible, none being less than twelve feet long, and the butt-joints must come on the piles. They are to be spiked to the piles with $\frac{3}{8}$ inch square wrought-iron ship-spikes six inches long.

On the northerly and easterly lines the planking shall be still further secured by strips of spruce plank three inches by six inches well driven into the mud, and reaching to the top of the planking, and bolted through to the main piles by three $\frac{3}{4}$ inch screw-bolts.

All the timber to be sound, sawed square, and free from large knots.

All the work to be done in a neat and workmanlike manner, in accordance with the lines graded and instructions given by the engineer, and to the satisfaction of the commissioners and the engineer.

The work is to be commenced within a reasonable time, and prosecuted continuously in all suitable weather, till its completion.

The said party of the second part hereby covenants and agrees with said party of the first part to pay said party of the first part for said bulkhead at the rate of \$3.59 per lineal foot, and for said extra fastening to pay at the rate of \$1 65 for each six lineal feet of bulkhead when said extra fastening is put on.

Monthly estimates of the work done will be made by the engineer, and payment of ninety per cent of the contract-price will be made thereon, the remaining ten per cent to be retained until the completion, final measurement, and acceptance of the work.

It is agreed by and between the parties hereto, that upon all questions of measurement, lines, or grades, the decision of the engineer of said Board shall be final

In testimony whereof the said F. G. Whitcomb has hereunto set his hand and seal, and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by its Board of Harbor and Land Commissioners, the day and year above written, and the same to be approved by its Governor and Council.

F. G. WHITCOMB. [SEAL.]

THE COMMONWEALTH OF MASSACHUSETTS,

BY ALBERT MASON,

[SEAL OF THE
COMMONWEALTH.]

FRANCIS A. NYE,

HENRY L. WHITING,

Harbor and Land Commissioners.

IN COUNCIL, Sept. 20, 1881.

Approved.

HENRY B. PEIRCE, *Secretary.*

Recorded in vol. 2, Treaties, Contracts, etc., pp. 250-253.

ANNUAL REPORT

OF THE

Mass.
=

HARBOR AND LAND COMMISSIONERS,

FOR

THE YEAR 1882.

BOSTON:

WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
No. 18 POST OFFICE SQUARE.

1883.

Commonwealth of Massachusetts.

HARBOR AND LAND COMMISSIONERS' REPORT.

To the Honorable the Senate and the House of Representatives of the Commonwealth of Massachusetts.

The Board of Harbor and Land Commissioners, in accordance with the provisions of law, respectfully submit their Annual Report for the year 1882.

SOUTH BOSTON FLATS.

Two hundred and forty-four thousand yards of dredged material have been deposited on the flats at South Boston under the contract of August 12, 1881, with the New England Dredging Company, and fifty-seven thousand eight hundred and thirty-one yards under the contract of August 28, 1880, with Thomas Potter. The stipulation of the last-named contract, that the work under it should be completed before January 1, 1883, has not been kept; but the Commonwealth will suffer no detriment from the delay, as the adjoining reclamation will not be hindered, and no special advantage would be derived from the completion of the sixteen acres covered by this contract in advance of that adjoining. A supplementary agreement with the contractor, extending his time one year, has been executed.

About one hundred thousand yards of material dredged by the general government, and by private parties, have been obtained and deposited mostly on the area in rear of that covered by the above-named contracts, making a total of about four hundred and twenty thousand yards of dredged

material, — the largest amount placed upon the flats in any one year since the commencement of the work, and equivalent to nearly twenty acres of complete reclamation.

The amount of material obtained from outside the contracts with the Commonwealth, was much larger than had been anticipated, and proved larger than could be advantageously deposited without provision for lifting it to the grade prescribed for the Commonwealth's own work. The importance of securing this material was obvious, and the necessity of providing for its disposition with the maximum of advantage to the reclamation, and the minimum of disadvantage to navigation outside the area under reclamation, was imperative. Although the contracts already made were estimated to leave no more than a reasonable margin of the existing appropriation for the specific purpose of the reclamation, the character of the work to be done was so plainly that for which the income of the compensation fund could be used, that there seemed to the Board no question but that the entire appropriations available were adequate for all the work that need be undertaken.

A contract was accordingly made, on the first day of July, with the New England Dredging Company, to provide for receiving all the material that should be deposited from miscellaneous sources, raising the same, and placing it on the area in rear of that covered by its previous contract, leaving it, at grade thirteen, uniform with the other filling of dredged material. In connection with this measure, and as part of the inducement for adopting it, the Board effected an arrangement with riparian proprietors, who would be accommodated by confining the immediate operations of the Commonwealth to a smaller area than would otherwise be practicable, by which the Commonwealth will receive for the use of its unoccupied flats outside the area of present reclamation, one thousand dollars per year for three years. Copies of these several contracts will be found in the appendix.

B Street has been covered with gravel, as provided in the contract reported last year, and is now completed, so far as the Commonwealth is required to construct it, to Congress Street.

Negotiations have been re-opened for the purchase of the

larger of the outstanding fractional interests in the area of riparian ownership, which the Commonwealth had undertaken to obtain under chap. 446 of the Acts of 1869, and the Board are hopeful of a successful conclusion at an early day.

As the work involved in the South Boston reclamation proceeds, its success as an advantageous development of the great property of the State, and as a scheme of harbor improvement and utilization, seems more fully assured. Already its prosecution has added fifty acres to the deep-water area of the harbor, and a series of docks and piers that may be justly the pride of any harbor, while the frontage remaining for development is adequate for the accommodation of indefinite growth.

Mistakes in treatment of the reclaimed area may thwart the full commercial advantage to the community which might be secured by adhering to well-considered and comprehensive plans, and may greatly reduce the amount to be realized to the treasury; but no mistakes that have been made, or that are likely to occur, can probably prevent the Commonwealth's enterprise from proving a signal benefit to its commercial centre, and bringing a large contribution to its treasury.

CLAIMS AGAINST THE BOSTON & ALBANY R.R. CO.

The claims of the Commonwealth against the Boston & Albany Railroad Company, were put in suit under the provisions of chap. 50 of the Resolves of 1880. Negotiations for settlement, pursuant to chap. 58 of the Resolves of 1881, have been in progress since the passage of the latter resolve, and have resulted in a settlement for the sum of \$100,000, upon the terms stated in the agreement printed in the appendix. A determination, in the courts, of all the controverted questions involved in these claims, could only be effected by litigation indefinitely prolonged. It was obviously desirable that a settlement should be effected, if any reasonable concessions could bring the parties together. The position of the Commonwealth, in relation to the amounts directly accruing under the terms of the several contracts, had been so liberally and temperately stated by the Board in earlier negotiations, that the present Board found little

remaining, beyond minor corrections of areas and amounts, resulting from modifications of lines, that could, with due regard to the rights of the Commonwealth, be conceded.

The balance actually due to the Commonwealth under the contracts, exclusive of claims for interest and damages, was \$66,929.32. The claim for damages by reason of delay in the prosecution of the stipulated reclamation of the flats sold, seemed to us, as to our predecessors, to be a valid one; but, upon careful consideration, in the light of the instructions of the proper legal adviser of the Board, the amount likely to be recovered seemed exceedingly problematical. It was evident that large consequential damages, fairly assumed to have resulted from such delay, would be excluded by the rules of law applicable to such liability, and that what would remain would be of vague and uncertain amount, and not likely to be large. By practically waiving this indefinite claim, the settlement reached has been effected. While the Board are conscious that the concessions made have been liberal, they believe the true interests of the Commonwealth have been secured by the action taken.

BACK BAY LANDS.

	FEET.
In 1857 the Commonwealth owned on the Back Bay, .	4,723,998
Of which there have been donated,	363,308.00
Devoted to streets and passage-ways,	2,037,068.60
Sold as per last report,	2,221,027.80
Sold in 1882,	14,425.60
	<u>2,235,453.40</u>
Remaining for sale Dec. 31, 1882,	88,168.00
	<u>4,723,998</u>
The gross proceeds of land sold as per last report,	\$1,706,636 77
The gross proceeds of land sold in 1882,	48,602 40
	<u>\$1,755,239 17</u>
Rights in Parker Street sold as per last report,	2,300 00
	<u>\$1,757,539 17</u>
Cost of filling, grading, etc., as per last report,	\$1,626,008 71
Cost of auction sales as per last report,	14,291 78
	<u>1,640,300 49</u>
Net proceeds to Dec. 31, 1882,	\$3,117,238 68

There have been sold in 1882 as follows : —

6,025.60 feet Marlborough Street, north side,		
for	\$25,502 40	
8,400 feet Newbury Street, south side, .	23,100 00	
	<hr/>	\$48,602 40

The average price per foot obtained in 1882 was \$3.3691, the lowest price \$2.75, and the highest price \$4.50.

The sales have been much less than in 1881; but there has been no decrease in prices, and the amount of land remaining unsold is so small that no apprehension is felt but that as good prices will be obtained for all that remains.

The land unsold is located as follows : —

Marlborough Street, north side,	10,752 ft.
Commonwealth Avenue, south side,	3,237
Newbury Street, north side,	12,320
Newbury Street, south side,	17,808
Boylston Street, north side,	36,176
Boylston Street, south side,	7,875
	<hr/>
	88,168 ft.

The value of the remaining land cannot be less than \$200,000.

TIDE LANDS.

The amount received during the past year for the occupation of the land of the Commonwealth, under the licenses of the Board authorizing wharf and other structures in tide-water, is \$11,733.15. The total amount received and paid into the State treasury since the passage of the law directing these assessments to be made, is \$140,469.10.

RESURVEY OF BOSTON INNER HARBOR.

During the past field season, the resurvey of the Inner Harbor, commenced in 1878, has been resumed, and some progress made, both in triangulation and topography, in extending it beyond the point of former limitation, at the pier of the East Boston elevator, to Jeffries Point, and still eastward to the Boston, Revere Beach & Lynn Railroad embankments. The scale of this work is the same as that adopted for the series of original maps, viz., $\frac{1}{10000}$.

MISCELLANEOUS SURVEYS.

The field surveys of the Board have involved more than

the average amount of yearly work. Besides the special surveys of Charles River, and of Salt Pond in Falmouth, described in detail elsewhere in this report, the work of the Board has been substantially as follows :

In connection with the South Boston Flats reclamation, accurate surveys have been made, with calculations and estimates of areas and quantities, upon which the determination of the amount of work done by the contractors has been based. These surveys and determinations have been made each month as the work progressed. In connection with the same work, hydrographic surveys have been made in the main harbor basin, and in Fort Point Channel, for testing the areas and depths of the ground dredged.

A complete hydrographic survey has been made, on a scale uniform with the harbor resurvey ($\frac{1}{1000}$), of Fort Point Channel from its mouth to Federal Street bridge. This shows the improved condition of the channel effected by the special dredging operations which have been done mainly during the year, and also affords a basis for projecting further contemplated improvements.

The improvements already made in Fort Point Channel, below Congress Street bridge, consist in excavations by the Boston Wharf Company of about 20,000 cubic yards, over an area of about 30,000 square feet, making an average depth of about 19 feet at mean low water. On the part of the Commonwealth, the Board has excavated about 50,000 cubic yards, over an area of about 150,000 square feet, making a depth of 15 feet at mean low water. Above Congress Street bridge, the Standard Sugar Refinery Company has made excavations, in straightening and deepening the channel to 13 feet at mean low water, from Congress Street bridge to its wharf.

PHYSICAL SURVEY OF CHARLES RIVER.

During the past year, the Board has been applied to by some of the railroad companies whose bridges cross the channel of Charles River, for leave to occupy the water-spaces between some of these bridges, from the harbor line on the Boston side of the river out to the line of the present drawway openings, with pile structures similar in construc-

tion to the present bridges; and thus to acquire additional yard-room for multiplying switches, for better access to depots, and for other railroad uses.

While recognizing the importance of ample terminal facilities to successful railroad management, the Board could not but regard the appropriation of the deep natural channels of the harbor to such purposes, as a very serious matter, — particularly in connection with other projects, the success of which must, more or less, depend upon the peculiar treatment of the river; such as the plans of the Cambridge Improvement Company for providing better commercial frontage on the Cambridge side of the river, between Craigie and West Boston bridges; the improvement of the upper basin, contemplated in the scheme of the Park Commissioners; and the important enterprise in connection with ocean navigation, already undertaken by the Hoosac Tunnel Dock and Elevator Company, and requiring all the physical accessories and natural advantages possible. The proposition of the railroad companies is apparently not in harmony with the best development of these last-named projects, which are more truly in the line of harbor improvement.

The location and character of the numerous bridges which encumber the mouth and throat of Charles River, have always been considered as objectionable, and every well-devised scheme of harbor improvement has pointed to the correction of these injurious structures, as a *sine qua non* to the restoration of this channel to its fullest physical and commercial capabilities. So familiar are the facts and arguments bearing upon this subject, that it is unnecessary to repeat them here. With the largest latitude in favor of artificial methods of improvement, the peculiar configuration of Boston Harbor, with its succession of straits and basins, gives peculiar value to its natural tidal forces. The constantly recurring change of ten feet in the ocean level, and the power of its influences, are elements of security on the one hand, and of danger on the other, which no proper consideration of the conservation of the harbor can ignore.

It seemed to the Board that the possible or probable effects of the proposed changes in the bridges and pier lines of Charles River, involved the apparently conflicting interests

of commerce, by land on the one hand, and by water on the other, to such an extent that the petition of the railroad companies ought not to be granted, or refused, except upon the fullest knowledge of all the data which might aid in the right solution of the problem. There had been no physical survey of the Charles River for more than twenty years. The Board deemed it necessary, therefore, to make a re-examination and survey of this part of the harbor, in order to ascertain, if possible, by its results, how, and how much, if any, the water-space of the Charles River may be encroached upon by solid or pile structures, without injury to the present facilities of navigation. The peculiar configuration of Boston Harbor, as before remarked, and the pressure of the large tide into its arms and reservoirs, make it manifest that these facilities may be impaired by reducing the width and depth of channels; by augmenting the rush of water through the bridge-draws, which are the only means of access to the upper basins; or by producing unequal scour, and thereby creating excessive excavations in one place and obstructive shoaling in another.

One of the questions that has continually presented itself during the past twenty years, is this: Do piles, driven in rows across a channel, cause excavations between them, and, if so, is the material, thus excavated, deposited above or below the piling, to the injury of the channel, or to the injury of the discharge section, or to the deflection of the current? An important inducement to the proposed survey, was the obtaining of light on this and similar questions, by a comparison of the results of a new survey with those of the physical survey made in 1861, by Prof. Henry Mitchell of the Coast Survey, also one of the members of the United States Commission and Advisory Council for Boston Harbor. In ordering the work of the present survey, the Board has received most valuable counsel and advice from Prof. Mitchell as to the methods and details of the work, in order that the observations made might coincide in character and location with those of the former survey, thus making the results a true indication of the changes which have taken place. The present survey has been executed with the greatest care and accuracy, and every practicable means

adopted to insure the best physical results. We quote largely from the sub-report of our engineers in giving the items and particulars which it is most desirable to state. The Map appended to this report is also especially to be referred to, as exhibiting in a very full and satisfactory manner the results in detail.

The survey was made during August, September, and October, 1882. The area surveyed comprises that part of Charles River lying between its mouth, at the point of the United States Navy Yard, where it joins the waters of the Mystic River, and the West Boston bridge, where a natural bar separates the lower basin from the one above. The hydrographic survey was based upon the topographical survey of the upper harbor, made in 1878, and such changes in the lines of wharves and bridges as have taken place since that date, have been resurveyed. The same scale was adopted for the appended hydrographical map, as that of the topographical harbor survey, above referred to, viz., $\frac{1}{10000}$, which allows the greater part of the soundings taken to be plotted. The number of soundings taken was 12,815, and the position of each sounding has been accurately determined by instrumental observation and other approved methods. The soundings are referred to the plane of mean low tide (or 5.4 feet), on the standard tide-staff of the Coast Survey at the United States Navy Yard, equal to 14.7 feet below the coping of the dry dock.

Observations for slope of river were made simultaneously at fourteen different stations. Tide-staves were placed and referred to the standard tide-staff at the Navy Yard, at each of these stations, as follows: one above West Boston bridge; three above Craigie bridge; one below Craigie bridge; three below Lowell R. R. freight bridge; three above Lowell and Eastern R. R. bridge, and three below Charles River bridge. A whole tide, from one low-water through high-water to the following low-water, was observed on a tide of mean rise and fall. The results of these observations have been tabulated, and transverse curves of surface, at the several bridges, have been plotted. All observations have been tabulated and reduced to mean range of tide, equal to 9.8

feet, and plotted in plan and profile. From the transverse curves for each bridge, the curves of greatest velocity give the velocities which are represented by arrows on the plan. These arrows, therefore, show simultaneous velocities and corresponding directions, over the whole area observed, of the swiftest current on a tide of mean rise and fall.

Under Charles River bridge were found the remains of three old bridge piers of crib-work and stone, one of them being dry at low tide, and the other two in 26 feet of water. The piles supporting the bridges were counted and located on the map, and the direction of the bays in relation to the current indicated. The number of piles, as counted in the respective bridges, between the embankment walls, and between the harbor lines, is given in the following table :—

NAME OF BRIDGE.	NUMBER OF PILES.	
	Between embankment walls.	Between harbor lines.
Charles River and adjoining wharves,	2,030	1,000
Warren,	1,820	1,120
Fitchburg R. R.,	8,420	2,700
Boston & Maine R. R.,	4,400	3,200
Eastern and Lowell R. R.,	4,870	4,340
Lowell R. R. freight,	2,617	2,267
Craigie,	1,700	1,645
Total,	25,657	16,272

The gross amount in area of piling, between the pier lines on either side of Charles River, of the group of bridges from Charles River to West Boston bridge, inclusive, is about *forty-one acres*.

The maximum slope is shown to occur between the Lowell and Eastern R. R. bridge and Charles River bridge, where, in a length of 1,700 feet, a fall of 0.7 feet was observed on the maximum strength of the tide, equal to a degree of slope of 2 17 feet per mile.

It is noticeable that the greatest velocity maintains itself very nearly during two current hours (the fourth and fifth), both on the ebb and the flood tides.

The deepest place in the channel is directly above the Lowell and Eastern R. R. bridge, which has 30.6 feet at mean low water. From this point upward, the 23-foot channel trends towards the Cambridge shore, ending about 900 feet above Craigie bridge, and then gradually decreasing in depth to 10.2 feet over the “bar” at West Boston bridge. The navigable channel through the several draws has the following depths at mean low water and at mean high water:—

DEPTHS OF CHANNEL AT DRAWS.	At M. L. W. FEET.	At M. H. W. FEET.
At Charles River bridge draw,	26.0	35.8
Warren bridge draw,	14.3	24.1
Fitchburg R R bridge draw,	22.7	32.5
Boston & Maine R. R. bridge draw,	21.2	31.0
Lowell and Eastern R. R. bridge draw,	18.5	28.3
Lowell R. R. freight bridge draw,	26.2	36.0
Craigie bridge draw,	24.3	34.1
West Boston bridge draw,	8.2	18.0

A comparison of the results of the two surveys of 1861 and of 1882, shows the changes which have taken place during the time involved (21 years); and the following table gives the amount, in quantities and depths, of these changes in the bed of the river in the various sections of the area examined and compared.

Table showing changes that have occurred in Charles River between 1861 and 1882.

No. of Section.	LOCALITY.	SHOALING.		DEEPENING.		EXCESS OF SHOALING.		Average height of shoaling in feet.	Greatest shoaling in channel in feet.
		In cubic yards.	Over area in acres.	In cubic yards.	Over area in acres.	In cubic yards.	Over area in acres.		
1	From West Boston bridge to Craigie bridge, . . .	150,704	55.3	65,296*	25.5	85,408	80.8	0 65	4.7
2	Craigie bridge to Lowell freight bridge, . . .	48,704	7.4	37	-	48,667	7.5	4 04	5.4
3	Lowell freight bridge to Lowell and Eastern bridge,	173,233	24.6	-	-	173,233	24.6	4.37	7.7
4	Lowell and Eastern bridge to Boston & Maine bridge,	55,085	10.4	-	-	55,085	10.4	3.30	5.2
5	Boston & Maine bridge to Fitchburg bridge, . . .	73,559	14.6	-	-	73,559	14.6	3.12	4.8
6	Fitchburg bridge to Warren bridge, . . .	43,181	6.5	463	0.3	42,718	6.8	3.87	4.8
7	Warren bridge to Charles River bridge, . . .	70,544	12.8	207	0.6	70,337	13.4	3.24	5.8
8	Charles River bridge to mouth of river, . . .	165,359	45.5	3,741	2.7	161,618	48.2	2.08	3.8
Whole basin from West Boston bridge to mouth of river,		780,369	177.1	69,744	29.2	710,625	206.3	2 13	7.7

* Partly artificial, by dredging.

The deepening which has occurred is mainly confined to the basin above Craigie bridge, where the Boston side of the channel has been scoured deeper, and the Cambridge side has shoaled; the excess of shoaling being 85,408 cubic yards, over an area of about 80 acres. In the general channel the shoaling is greater than on the flats on either side of it. In one place in the channel, above the Lowell and Eastern railroad bridge, the shoaling is 7.7 feet. The greatest average shoaling, 4.37 feet, is in the basin between the Lowell and Eastern and the Lowell freight bridges, where the river meets the greatest number of pile obstructions.

The amount of shoaling found to have taken place in the bed of the channel, is a surprise to most of those who have speculated upon the probabilities, and is greater than Prof. Mitchell expected to find it. It would be logical to suppose that the piling, by narrowing up the section, would increase the velocity between the piles, and create a scouring force that might undermine the bridge structures. A comparison of the results of the two surveys proves a reverse action.

Our engineers submit the following conclusions :—

“ That the shoaling is due to obstructions caused by the piles is not to be doubted. They act as so many gratings through which the water has to be filtered, creating an artificial slope without the corresponding velocity; for, to a slope of 0.7 feet in 1,700 feet, or 2.17 feet of slope per mile, would belong a corresponding velocity of 8.9 feet per second, or *five and three-tenths miles per hour*, in the narrowest section if *unobstructed*; whereas, we find, by observation, a velocity of only *sixty-five hundredths of one mile*. With a *free section*, a slope of 0.0098, or *three hundredths of one foot per mile*, would be sufficient to produce the velocity observed.

“ The surplus ‘head’ created by the pile obstructions, is evidently used up in destroying the *vis viva* of the water, stopping its momentum, and allowing the sediment carried in it to drop and be deposited upon the bottom. It is therefore to be concluded that, so long as the pile structures remain in their present order and condition, the shoaling will continue in the same ratio as is found to exist between 1861 and 1882.

“ Another effect of the piling is to distort the tidal wave, increasing the axial delay, and extending the maximum velocity over a greater space of time, thereby preventing the proper reinforcement of the Mystic River tides by those of the Charles River and its basins.”

We have thus presented to our consideration an apparently paradoxical phenomenon. We find the river water piled up to an unnatural head, but without a corresponding movement to equalize its level; and, instead of increased velocity through the drawways, tending to cause excavation and to undermine the bridges, we find the water toiling slowly through the almost impenetrable forest of piles. The drawway openings, which might be expected to give some relief, are found to be inadequate to that purpose, and probably too narrow in proportion to the width of the river; and the water-spaces between the bridges allow the slope created within each drawway opening to diffuse itself, laterally, in each recurring water-space between the bridges, so that, instead of a continuous flow, particularly through the alignment of draws from the Lowell Railroad passenger bridge to the Warren bridge, the water forces its way by a succession of abrupt falls as it passes through each bridge, and then loses its headway.

We also find a large reduction in the depth of channel, and a markedly injurious effect upon the discharge section. It may be said that the shoaling which has taken place has not yet reached a point injurious to navigation. But it must be borne in mind that the work of shoaling going on is in the very deepest portion of the harbor, and, although it may take time to do practical injury, the action in that direction is steadily progressing. There are unknown elements, particularly in the phenomena of tidal action, the results of which it is difficult to predict. There are instances where the same class of forces as those at work here, viz., a tendency to shoal on the one hand, and an opposing force tending to maintain a channel-way on the other, have remained in equilibrium until some perhaps trifling predominance of shoaling power has so suddenly increased that action, that harbors and inlets have been destroyed in short spaces of time.

It is not practicable to discuss at length, in this report, the technical questions involved in the case before us. The manuscript map of the survey, with all the data of the observations, are in the archives of the Board for reference and examination. The reduced copy of the manuscript map

appended to the report, gives a better illustration of the main features of the river than can be conveyed in a written description. By examining this map, it will be seen how the obstruction of the river will be aggravated by the proposed encroachments.

The filling of the water-spaces between the bridges, from the present pier line on the Boston side out to the line of the drawway openings, virtually extends the Boston frontage to the draw line ; for, although the occupation of but one water-space is at present asked for (that between the Boston & Maine and the Eastern railroad bridges), if it be granted, there is no logic in refusing to allow the spaces between the other bridges to be similarly occupied.

The Board, therefore, is met by the grave and important question, whether it is wise and safe, notwithstanding the terminal advantages accruing to the railroads from the scheme proposed, to advance the pier line into the middle of the channel of Charles River. To do so would clearly be not only to violate all the traditions and teachings of scientific research, and to thwart the beneficial purpose and result of the establishment of harbor lines, but, as already intimated, possibly, and even probably, to conflict with or defeat other schemes of harbor conservation and improvement.

By examining the appended map, it will be seen that the 23-foot channel, at the very point where the encroachments are proposed, is entirely on the southerly side of the railroad draws, and between them and the Boston pier line. Filling the water-space in question will obstruct the whole of the 23-foot channel, even to the summit of the abrupt bank on its northern side, and fill the entire channel section with a dense pile structure.

We would also call attention to the peculiar formation and trend of the northerly bank of this 23-foot channel in its course from the Lowell Railroad freight bridge to the Warren bridge. No borings have been made to ascertain the character of the material of this bank, so to call it, but it gives evidence, by resisting the current forces from the upper basins, and deflecting them so markedly, of being firm and hard, and may be of antecedent formation. It is not the less impor-

tant to regard its influence in defining and maintaining the channel where it now is.

Whatever may be said, also, of the effect of the pile structures, they have hitherto exerted a uniform influence by their uniform position across the whole section of the stream. The question, therefore, naturally arises, What will be the consequences to the channel and the harbor if pile obstructions are increased one hundred per centum in one half of the river-bed, while the other half is left unchanged?

In view of the facts presented, and after careful consideration of the interests and dangers involved, the Board does not feel justified in authorizing the further occupation of the water-spaces in the manner proposed.

MERRIMAC RIVER.

In accordance with chap. 23 of the Resolves of 1881, the Board made an examination, and submitted a statement in its last annual report, of the condition of the draws in the bridges crossing the Merrimac River below Haverhill, with a view to the improvement of the navigation of the river. Very satisfactory work has been done during the past year in carrying out the recommendations of the Board. By the courtesy of Mr. Charles A. Putnam, of Salem, the engineer who has had charge of the work in question, the Board is able to report the following particulars.

In consequence of defects in one of the spans of the Groveland bridge, the county commissioners determined to rebuild the entire superstructure, and, in place of the old style of leaf-draw, to remove one of the old draw-piers, and build a new circular stone pier for a pivot-draw, with a wooden fender pier. This work was done by Messrs. Ross & Parker, and a wrought-iron riveted bridge structure, built by the Boston Bridge Company, was erected, — the entire work costing about \$73,000.

The work on the Deer Island bridge, in Salisbury, is now progressing rapidly, and will probably be finished in March. The stone work of the piers and abutments, and the timber work of the draw-piers, and the removal of the present old bridge, which is to remain until the new bridge is open for

travel, were awarded to, and are being done by Messrs. Ross, Greely & Blaisdell. The bridge proper is a wrought-iron riveted structure, built by the Boston Bridge Company. The new draw is a circular pivot-draw, with clear openings on either side of the central pier of 56 feet at the low-water line. The length of the bridge between abutments is $397\frac{1}{2}$ feet. The cost of the work is \$92,000.

The proposed work at Rocks Bridge, between Haverhill and West Newbury, will include the removal of the present draw and the first main span south of it, and also of the present southerly pier of the old draw, and the building in place thereof of a new circular stone pier and a stone side pier. The drawway openings on either side of the central pier will be 56 feet in the clear at the low-water line. The entire length of this new structure will be about 219 feet. The stone work, dredging and timber work have been awarded to Mr. Joseph Ross, and the bridge, which is to be a wrought-iron riveted structure, to the Boston Bridge Company. The entire cost of the work will be about \$41,000.

The Eastern Railroad Company has completed the new timber fender draw-pier at its bridge at Newburyport, the entire cost being about \$10,000.

These bridge improvements will greatly facilitate the navigation of the Merrimac. Through the wise foresight of Mayor Howe of Haverhill, a careful study of the frontage of that city upon the river has also been made, and, at his instance, a careful survey and plan prepared, as the basis for the alignment of future wharf structures.

The work done in this river by the general government, has been in charge of General George Thom, U. S. Engineers, and the appropriation of \$9,000, made August 2, 1882, has been expended in improving the channel by dredging, and removing dangerous sunken rocks at the Lower Falls above Haverhill, and at Rocks Bridge below that city. The ledge near the outlet of Newburyport harbor, known as South Badger ledge, has also been broken up and removed to a depth of $9\frac{1}{2}$ feet at mean low water.

ARTIFICIAL HARBORS.

Salt Pond in Falmouth.

A petition was presented to the Board by citizens of the town of Falmouth, mainly those residing near the seashore south of the main village, for authority to open the beach, and to make an artificial channel connecting the waters of the Vineyard Sound with those of Salt Pond, in Falmouth, with a view to making the latter a harbor of refuge such as the depth and area of the pond might afford.

The proposed undertaking involved the probabilities of the success of an interesting and useful project, with results not only of local but of general value, inasmuch as the pond in question, by reason of its proximity and relations to the beach and ocean waters beyond, was a type of others along the shores of the Commonwealth, the improvement and utilization of which would be a public benefit.

The Board had not sufficient data on which to base an intelligent judgment regarding the feasibility of this project. It was deemed expedient, therefore, to make a survey of Salt Pond, and of its surroundings and physical relations to the outside waters of the Sound, in order to ascertain how far the project of making it an artificial harbor might be practicable.

The result of such tidal observations as it was practicable to make, determined the surface of the pond, in its present state, to be somewhat above the mean high-water plane of the Sound; and the tidal volume, through the present small and imperfect inlet, to be so inconsiderable as to affect but slightly the rise and fall of the water in the pond.

An opening through the beach, of sufficient depth and width to answer the purposes of a navigable channel, would, of course, change the regimen of the pond, so that the full rise and fall of the tides without would be maintained within it. This tidal action would have two physical effects; one, to create possible scour and disturbance of the bottom, particularly through the excavated channel, and where it debouches upon the Sound; and the other, to change the character of the margin of the pond from its present uniform condition to a "strand," with exposed flats between the high and low water lines.

Owing to the purity of the water of the Sound, and the sandy nature of the shore of the pond, there seems to be no cause for apprehending unpleasant or injurious effects from any changes which might occur.

It is more difficult to predict the consequences of the tidal currents through the proposed opening; but the only important question, in this connection, is their probable effect upon the permanency of the opening. To maintain an opening, it would undoubtedly be necessary to secure the sides of the excavated channel.

The outside protection to the opening is a matter of still greater importance, and more uncertainty. The Board is not possessed of sufficient data to enable it to prescribe advisedly in regard to it. The small stone pier and dock, near the site of the proposed opening, have withstood the wave and current action upon this shore for about sixty years, with but slight, if any, change in the entrance or depth of water inside the dock. But this structure has not created the tidal disturbance, nor produced the local current, likely to occur in the tidal inflow and outflow of Salt Pond. With the slight rise and fall of the tides, and the small reservoir capacity of the pond, the currents might not have sufficient power to injuriously affect the opening. The element of greatest danger and most uncertainty would be the sea-dash upon the shore. What effect this might have, and how violent it might be, cannot be determined without further observation.

Considering all the conditions and contingencies involved, the Board feels justified in recommending the project as a feasible one.

With regard to the utility of such a work, it can certainly be classed as a valuable coast improvement. It would create a harbor of refuge upon an exposed shore; and, although the entrance would be limited, the shelter within would be secure. The depth of water contemplated and practicable, — six or eight feet at mean low tide, — would admit vessels of considerable size and in considerable numbers; and the project, if successful, would have an importance beyond its local utility, by suggesting similar works in other localities, where the results might be of equal and even greater value.

The area of the pond, in its present natural state, is 61.4 acres ; its anchorage area, inside the line of six feet depth at mean low water, would be 24.3 acres ; and, inside the line of eight feet depth, 20 acres.

A map of the pond and beach, showing in detail the results of the survey made by the engineers of the Board, is on file in this office for reference and examination.

BOUNDARY LINES BETWEEN CITIES AND TOWNS BORDERING UPON THE SEA.

The Board has continued, during the last year, the work devolved upon it by chap. 196 of the Acts of 1881, of locating and defining the boundary lines between cities and towns bordering upon the sea, from high-water mark outward to the line of the Commonwealth.

The preliminary step of locating and defining the line which bounds the territorial limits of the Commonwealth, extending "one marine league from its seashore at low-water mark," had been taken the preceding year ; and the line of the Commonwealth, so established, was fully described, by metes, courses and bounds, in the last annual report. In extending the boundary lines of cities and towns out to this exterior line of the Commonwealth, it has been found necessary for the Board, or its engineers, to visit the points where the lines of land division, already established between the several cities and towns, terminate upon the shore ; and a description and sketch of the monument or bound by which each of these points is marked, has been taken. Most of the localities where the terminal point is at the mouth of a river or inlet, have also been examined.)

During the summer, the Board appointed meetings with the mayor and aldermen of the city of New Bedford, and with the selectmen of the towns of Westport, Dartmouth, Fairhaven, Mattapoisett, Marion, Wareham, Falmouth, Gosnold, Gay Head, Chilmark, Tisbury, Edgartown and Nantucket, respectively, and held conferences with them in regard to their several boundary lines ; and is under obligation to these gentlemen for valuable information and assistance.

So far as practicable, the Board has endeavored to adopt

and carry out a uniform system in locating the division lines of water jurisdiction, based upon mathematical principles, and upon geographical and physical conditions ; and has thus been able to avoid, in great measure, the necessity of deciding controverted facts, and the pressure of local feeling and interest. In most cases, the departure or bearing of the boundary line has been governed by the trend of the adjacent shores, or the relation of the adjacent headlands. Where the line has passed through bays, coves, sounds, channels or straits, as in the case of the general dividing line between the respective towns on either side of Buzzard's Bay, Vineyard Sound, Muskeget Channel, Wood's Holl and Cohasset Narrows, the rule has been to determine the central point in each successive water-space by measurements from a number of headlands or points, surrounding or adjacent to such water-space, sufficient to mathematically determine its position, and then to run the boundary line from one such central point to another throughout the course of the general line. A line so located and defined can be mathematically reproduced by referring to the same plans of the United States Coast Survey which the Board has made its basis of projection, and of which a copy is to be filed in the office of the Secretary of the Commonwealth, and in the Registry of Deeds of the county in which the line is situated, and also in the office of the Harbor and Land Commissioners ; or by reference to any other accurately executed map, or by direct bearings and measurements from the points and headlands indicated on the plans of the Board.

But few questions of disputed municipal jurisdiction have arisen in the determination of the lines thus far located. In the case of the boundary line between Edgartown and Nantucket, the question arose as to how far the jurisdiction over Muskeget and Gravel Islands, claimed by Edgartown, might affect the jurisdiction over the waters adjacent to these islands and to the respective towns. After careful consideration, and in view of the peculiar geographical relations of the respective territories, and as the more equitable solution of the question, the ruling of the Board has been, that the boundary line of water between the towns of Edgar-

town and Nantucket, should run through the main Muskeget Channel, and should be located and defined by means of, and upon the basis of, measurements of the same character from the headlands of Edgartown on the west side of the Channel, and from those of Nantucket on the east side; and that the jurisdiction of Edgartown over the land of Muskeget and Gravel Islands should not affect the jurisdiction of Nantucket over the waters surrounding them.

In the case of the boundary line between the city of New Bedford and the town of Fairhaven, the southerly end of this line is established, by chap. 130 of the Acts of 1811, at the "mouth of Acushnet River." After conference with the representatives of the respective municipalities, and in accordance with the construction adopted and acted upon by them during a long series of years, the "mouth of Acushnet River" was interpreted to mean the water-space between Fort Point on the easterly or Fairhaven side, and the opposite shore of Clark's Point on the westerly or New Bedford side. The system already described was followed in determining the precise central point within this water-space, from which to extend the boundary line of water between the city and town in question, to the general division line of Buzzard's Bay.

In like manner, the boundary line between the towns of Marion and Wareham was located and defined at the central point in the mouth of the Weweantic River, and extended from this point to the general division line of Buzzard's Bay. The same method was applied in other cases.

The boundary line which was the occasion of the most controversy, and where the claims contested were of the largest value and importance, was that between the towns of Wareham and Sandwich. It would be impracticable to discuss at length in this report the points at issue. As in the case of Edgartown and Nantucket, the difficulty arose from the existence of islands lying within the water area to be apportioned between the towns, — it being controverted, first, to which town the islands belonged, and, that question being settled, second, how far the islands should control or modify the division of the water area. Hearings were had at Buzzard's Bay, and at the office of the Board, and counsel

heard in behalf of each town. Upon first consideration, the Board located what was, to a certain extent, a compromise line; and, in anticipation of the full completion of its work, gave to each town a sketch illustrating such proposed location. It is understood that the location so indicated is not wholly satisfactory to either town, and is not likely to be accepted as a final settlement of the boundary question. Under these circumstances, upon further deliberation, and after a fuller study of this and other similar cases, the Board has felt obliged to reconsider its first action, and to adopt a different method of division, which is, in its judgment, the best and most equitable solution of the difficulties involved in this class of cases.

The method referred to is that already stated in general terms, namely: that when the water area to be divided lies *between* two towns, it is to be apportioned to the towns by a line drawn through its middle or central points; that the position of these points is to be determined by measurements outward from the shores and headlands of the *mainlands* of the respective towns; and that *islands* lying within this water area, and of inconsiderable size as compared with the whole territorial area of the towns, are to be disregarded in locating the line of water division, both in respect of their geographical position and of the municipality to which they belong.

In other words, the Board is charged with the duty of an equitable division of the tide-water areas of the Commonwealth between the several cities and towns, for purposes of municipal jurisdiction, and for the enjoyment of the rights and privileges which result therefrom. The Board has no power to change the limits of their land jurisdiction. It leaves these as it finds them. But there is no apparent reason why one town may not have jurisdiction over an island surrounded wholly or in part by waters which are within the jurisdiction of another town. To hold that the land area of a town extends, for purposes of water division, to the furthest point of its remotest island, would require, in some cases, the apportionment to such town, at the expense of another town, of hundreds or thousands of acres of water for each acre of island. The only equitable or practicable rule in

such cases, is to draw the line of water division where it fairly belongs, taking all the other elements into account, and leave the islands to drop where they may.

Between the towns of Provincetown and Truro some complications existed, owing to the accretion of land upon the East Harbor shore, and the consequent encroachment of the land upon what was water when the original terminal point of boundary was established. The action of the Board has been to extend the boundary line as nearly in conformity as possible to the original water-spaces, and to connect it with a newly located terminal point at the present shore line.

Beginning at the southerly extremity of the coast line of the Commonwealth, the Board was met by the difficulty that the first line in order, the westerly line of Westport, was not only a town line, but also the boundary line between the waters of the States of Massachusetts and Rhode Island, which the Board had no authority to establish. It seemed important, therefore, before proceeding with the boundary lines between the towns, to provisionally locate and define a line of boundary between the waters of the States, leaving its legal establishment to the legislative action of the States respectively. In order that no misunderstanding or conflicting action might occur, the Board submitted a description of its location of the inter-state line to the Board of Harbor Commissioners of Rhode Island, who not only fully concurred in what this Board had done, but took measures to secure the legislative sanction of the latter State; and an act was passed by the Senate of Rhode Island "To establish the boundary line between the waters of the State of Massachusetts and the State of Rhode Island and Providence Plantations." This act was pending before the House when it adjourned, so that it requires further action to become a Rhode Island law. A draft of an act for concurrent legislation on the part of Massachusetts, which is respectfully submitted to the consideration of the legislature, is appended to this report.

The Board does not understand that the act directing it to locate and define the lines of water boundary, requires it to report in detail to the legislature as a part of the legal

action necessary to establish them. But, as this work has occupied a considerable part of its attention, and is of interest to the seaboard municipalities, the Board submits the foregoing statement, and the following description of lines already located, for the information of the legislature and the public :

*Boundary Line between Rhode Island and Massachusetts,
and between Little Compton and Westport.*

The boundary line between the waters of the State of Rhode Island and Providence Plantations and the State of Massachusetts, which is also the boundary line between the waters of the town of Little Compton in the former, and the town of Westport in the latter State, is located and defined as follows: Beginning at the south-western corner of the territorial limits of the Commonwealth of Massachusetts, at a point in latitude $41^{\circ} 25' 5''$, longitude $71^{\circ} 5' 28''$, and distant one marine league from the shore line, which is a line from the headland at Warren's Point in Rhode Island to the headland at Gooseberry Neck in Massachusetts; and thence running northerly to the point on the shore at the southerly end of the State boundary line between Rhode Island and Massachusetts, as heretofore established by law.

Boundary Line between Westport and Dartmouth.

The boundary line between the waters of the towns of Westport and Dartmouth is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running south $34^{\circ} 30'$ east to the line of the Commonwealth.

Boundary Line between Dartmouth and New Bedford.

The boundary line between the waters of the town of Dartmouth and the city of New Bedford is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running south-easterly to a central point, marked 1 on plan, at the mouth of Clark's Cove; thence still south-easterly to a point, marked 2 on plan, in a line drawn from Dumpling Rocks to

Sconticut Neck, and one-third of the distance of the length of said line measuring from Dumpling Rocks; thence south more easterly to a point, marked 3 on plan, in the general division line between the towns on either side of Buzzard's Bay, as said general division line has been located and defined, and is shown on plan.

Boundary Line between New Bedford and Fairhaven.

The boundary line between the waters of the city of New Bedford and the town of Fairhaven is located and defined as follows: Beginning at the end of the boundary line as heretofore established at a central point, marked 1 on plan, in the mouth of Acushnet River, and running south-easterly to a central point, marked 2 on plan, in the head waters of New Bedford harbor; thence south-east more southerly to a point, marked 3 on plan, in a line drawn from Dumpling Rocks to Sconticut Neck, and one-third of the distance of the length of said line from Sconticut Neck; thence south-east more easterly to a point, marked 4 on plan, in the general division line of Buzzard's Bay, as hereinbefore described.

Boundary Line between Fairhaven and Mattapoisett.

The boundary line between the waters of the towns of Fairhaven and Mattapoisett is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running south-easterly to a central point, marked 1 on plan, in the head waters of the cove between Sconticut and Mattapoisett necks; thence south more easterly to a central point, marked 2 on plan, in the mouth of the cove above named; thence east more southerly to a point, marked 3 on plan, in the general division line of Buzzard's Bay, as hereinbefore described.

Boundary Line between Mattapoisett and Marion.

The boundary line between the waters of the towns of Mattapoisett and Marion is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running south-easterly to a central point, marked 1 on plan, in the mouth of Aucoot

Cove; thence east more southerly to a point, marked 2 on plan, in the general division line of Buzzard's Bay, as hereinbefore described.

Boundary Line between Marion and Wareham.

The boundary line between the waters of the towns of Marion and Wareham is located and defined as follows: Beginning at the end of the boundary line as heretofore established at the junction of the Sippican and Weweantic rivers, and running south-easterly, following the central line of the said Weweantic River, to a central point, marked 1 on plan, in the mouth of the said Weweantic River; thence easterly to a central point, marked 2 on plan, in the inner part of the water-space at the common mouth of the said Weweantic and the Wareham rivers; thence south-easterly to a central point, marked 3 on plan, in the outer part of the water-space aforesaid; thence east more southerly to a central point, marked VIII on plan, in the water-space at the head of Buzzard's Bay, which central point is also the north-easterly end of the general division line of Buzzard's Bay, as hereinbefore described.

Boundary Line between Wareham and Sandwich.

The boundary line between the waters of the towns of Wareham and Sandwich is located and defined as follows: Beginning at the end of the boundary line as heretofore established, at a central point, marked 1 on plan, in the mouth of Red Brook, and running south-easterly to a central point, marked 2 on plan, in the south-westerly corner of Buttermilk Bay; thence southerly, south-easterly, and south-westerly, following the central line of Cohasset Narrows, to a central point, marked 3 on plan, in the first enlarged water-space below said Narrows; thence southerly to a central point, marked 4 on plan, in the next succeeding water-space; thence south-westerly to a central point, marked 5 on plan, in the next succeeding water-space; thence south-easterly to a central point, marked 6 on plan, in the next succeeding water-space; thence south-westerly to a point, marked 7 on plan, midway between the headlands on either side the water-space; thence still south-westerly to a central point,

marked 8 on plan, in the next succeeding water-space; thence south-easterly to a central point, marked 9 on plan, in the next succeeding water-space; thence southerly to a central point, marked 10 on plan, in the next succeeding water-space; thence still southerly to a central point, marked 11 on plan, in the next succeeding water-space; thence south-westerly to a central point, marked 12 on plan, in the next succeeding water-space; thence still south-westerly to a central point, marked VIII on plan, in the next succeeding water-space, which is the water-space at the head of Buzzard's Bay, said central point being also the easterly end of the general division line of Buzzard's Bay, as hereinbefore described.

Boundary Line between Sandwich and Falmouth.

The boundary line between the waters of the towns of Sandwich and Falmouth is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running north $88^{\circ} 40'$ west, to the general division line of Buzzard's Bay, as hereinbefore described.

Boundary Line between Falmouth and Gosnold.

The boundary line between the waters of the towns of Falmouth and Gosnold is located and defined as follows: Beginning at a point equally distant, southerly, about seven-twelfths of a mile, from each of the headlands forming the southerly entrance to Wood's Holl, as shown on a sub-plan, being the United States Coast Survey harbor chart of Wood's Holl, which point is marked 1 on said sub-plan, and running south $28^{\circ} 30'$ east, to the general division line between the towns on either side of Vineyard Sound, as said general division line has been located and defined, and is shown on plan. Again, beginning at the first named point, marked 1 on sub-plan, and running north-westerly to a central point, marked 2 on sub-plan, in the southerly mouth of the passageway of Wood's Holl; thence still north-westerly to a central point, marked 3 on sub-plan, in the mouth of Great Harbor; thence westerly to a central point, marked 4 on sub-plan, in the passageway aforesaid; thence still

westerly to a central point in said passageway, marked 5 on sub-plan; thence north-westerly to a central point in said passageway, marked 6 on sub-plan; thence north-westerly to a central point in said passageway, marked 7 on sub-plan; thence northerly to a central point in the northerly mouth of said passageway, marked 8 on sub-plan; thence still northerly to a point, marked 9 on sub-plan, equally distant from the headlands forming the northerly entrance to Wood's Holl; thence north $53^{\circ} 15'$ west, to the general division line between the towns on either side of Buzzard's Bay, as hereinbefore described.

Boundary Lines between Gay Head and Chilmark.

The boundary line between the waters of the towns of Gay Head and Chilmark, on the Vineyard Sound side, is located and defined as follows: Beginning at the end of the boundary line as heretofore established at the mouth of Menamsha Creek, and running north 29° west to the general division line of Vineyard Sound, as hereinbefore described.

The boundary line on the ocean side begins at the end of the boundary line as heretofore established on the shore, and runs south $47^{\circ} 10'$ west to a point, marked 1 on plan, in the line connecting the most westerly headlands of Gay Head and No Man's Land; thence due west to a point, marked 2 on plan, in the line of the Commonwealth.

Boundary Lines between Chilmark and Tisbury.

The boundary line between the waters of the towns of Chilmark and Tisbury, on the Vineyard Sound side, is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running north $54^{\circ} 30'$ west to the general division line of Vineyard Sound, as hereinbefore described.

The boundary line on the ocean side begins at the end of the boundary line as heretofore established on the shore, and runs south 5° east to the line of the Commonwealth.

Boundary Line between Tisbury and Edgartown.

The boundary line between the waters of the towns of Tisbury and Edgartown is located and defined as follows:

Beginning at the end of the boundary line as heretofore established on the shore, and running south $1^{\circ} 40'$ east to the line of the Commonwealth.

Boundary Line between Edgartown and Nantucket.

The boundary line between the waters of the towns of Edgartown and Nantucket is located and defined as follows : Beginning at a point, marked M¹⁰ on plan, in the line of the Commonwealth on the Nantucket Sound side, in latitude $41^{\circ} 23' 15''$, longitude $70^{\circ} 19' 15''$, and running south-westerly to a point, marked 1 on plan, in latitude $41^{\circ} 19' 23''$, longitude $70^{\circ} 22' 02''$; thence south $11^{\circ} 30'$ west to the line of the Commonwealth on the ocean side.

Boundary Line between Edgartown and Cottage City.

The boundary line between the waters of the towns of Edgartown and Cottage City is located and defined as follows : Beginning at the end of the boundary line as heretofore established at a central point in the inlet of Sengekontacket Pond, and running north-easterly to a point, marked 1 on plan, equally distant from the headlands at East Chop, Edgartown and Cape Poge; thence east more northerly to a point, marked 2 on plan, in the general division line of Vineyard Sound, as hereinbefore described.

Boundary Line between Cottage City and Tisbury.

The boundary line between the waters of the towns of Cottage City and Tisbury is located and defined as follows : Beginning at the end of the boundary line as heretofore established at and through the lagoon bridge, so called, and running north $39^{\circ} 30'$ west to a point, marked 1 on plan, midway between the shores of Vineyard Haven harbor; thence north-easterly to a central point in the mouth of said harbor, marked 2 on plan; thence east more northerly to a point, marked 3 on plan, in the general division line of Vineyard Sound, as hereinbefore described.

Boundary Line between Falmouth and Mashpee.

The boundary line between the waters of the towns of Falmouth and Mashpee is located and defined as follows :



OF THE
OLD COLONY RAILROAD
AND
CONNECTIONS.



Beginning at the end of the boundary line as heretofore established, at a central point in the mouth of the outlet of Waquoit Bay, and running south $7^{\circ} 15'$ east to the general division line of Vineyard Sound, as hereinbefore described.

Boundary Line between Mashpee and Barnstable.

The boundary line between the waters of the towns of Mashpee and Barnstable is located and defined as follows: Beginning at the end of the boundary line as heretofore established, at a central point in the mouth of the outlet of Popponesset Bay, and running south $37^{\circ} 45'$ east to the line of the Commonwealth.

Boundary Lines between Barnstable and Yarmouth.

The boundary line between the waters of the towns of Barnstable and Yarmouth, on the Nantucket Sound side, is located and defined as follows: Beginning at the end of the boundary line as heretofore established, and running southerly and westerly, following substantially the line of the channel of Lewis Bay, to a central point, marked 1 on plan, in the mouth of its outlet; thence running south-westerly to a central point, marked 2 on plan, in a line drawn from Point Gammon to Hyannis Point; thence running south $1^{\circ} 15'$ west to the line of the Commonwealth.

The boundary line on the Massachusetts Bay side, begins at the end of the boundary line as heretofore established, at the central point in the mouth of Mill Creek, and runs north $11^{\circ} 45'$ west to the line of the Commonwealth.

Boundary Lines between Yarmouth and Dennis.

The boundary line between the waters of the towns of Yarmouth and Dennis, on the Nantucket Sound side, is located and defined as follows: Beginning at the end of the boundary line as heretofore established, at a central point in the mouth of Bass River, and running south 15° east to the line of the Commonwealth.

The boundary line on the Massachusetts Bay side, begins at the end of the boundary line as heretofore established, at the central point in the mouth of Bass Hole, and runs north $12^{\circ} 30'$ west to the line of the Commonwealth.

Boundary Line between Dennis and Harwich.

The boundary line between the waters of the towns of Dennis and Harwich is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running south $11^{\circ} 30'$ east to the line of the Commonwealth.

Boundary Line between Harwich and Chatham.

The boundary line between the waters of the towns of Harwich and Chatham is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running south 27° west to the line of the Commonwealth.

Boundary Line between Chatham and Orleans.

The boundary line between the waters of the towns of Chatham and Orleans is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running south $85^{\circ} 15'$ east to the line of the Commonwealth.

Boundary Lines between Orleans and Eastham.

The boundary line between the waters of the towns of Orleans and Eastham, on the ocean side, is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running north 82° east to the line of the Commonwealth.

The boundary line on the Massachusetts Bay side, begins at the central point in the mouth of Rock Creek, and runs north $68^{\circ} 30'$ west to the line of the Commonwealth.

Boundary Lines between Eastham and Wellfleet.

The boundary line between the waters of the towns of Eastham and Wellfleet, on the ocean side, is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running north $75^{\circ} 30'$ east to the line of the Commonwealth.

The boundary line on the Massachusetts Bay side, begins at the central point in the mouth of Hatch's Creek, and runs south $79^{\circ} 25'$ west to the line of the Commonwealth.

Boundary Lines between Wellfleet and Truro.

The boundary line between the waters of the towns of Wellfleet and Truro, on the ocean side, is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running north $64^{\circ} 30'$ east to the line of the Commonwealth.

The boundary line on the Massachusetts Bay side, begins at the end of the boundary line as heretofore established on the shore, and runs south $74^{\circ} 30'$ west to the line of the Commonwealth.

Boundary Lines between Truro and Provincetown.

The boundary line between the waters of the towns of Truro and Provincetown, on the ocean side, is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running north $13^{\circ} 45'$ east to the line of the Commonwealth.

The boundary line on the Massachusetts Bay side, begins at the end of the boundary line as heretofore established, at a stone post standing on the shore of East Harbor as the same was at the time said line was established, and runs south-easterly, in the course of said boundary line extended, a distance of 730 feet to a point, marked 1 on a sub-plan, being the United States Coast Survey harbor chart of Provincetown harbor; thence south-westerly to a point in the centre of the State dike, marked 2 on sub-plan; thence south 1° west a distance of $5\frac{7}{8}$ statute miles to a point marked 3 on sub-plan; thence south $62^{\circ} 40'$ west to the line of the Commonwealth.

Boundary Line between Orleans and Brewster.

The boundary line between the waters of the towns of Orleans and Brewster is located and defined as follows: Beginning at the end of the boundary line as heretofore established, at the central point in the mouth of Skaget Creek, and running north $62^{\circ} 45'$ west to the line of the Commonwealth.

Boundary Line between Brewster and Dennis.

The boundary line between the waters of the towns of Brewster and Dennis is located and defined as follows: Beginning at the end of the boundary line as heretofore established, at the central point in the mouth of Quivett Creek, and running north $22^{\circ} 30'$ west to the line of the Commonwealth.

Boundary Line between Barnstable and Sandwich.

The boundary line between the waters of the towns of Barnstable and Sandwich is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running north $3^{\circ} 30'$ east to the line of the Commonwealth.

Boundary Line between Sandwich and Plymouth.

The boundary line between the waters of the towns of Sandwich and Plymouth is located and defined as follows: Beginning at the end of the boundary line as heretofore established on the shore, and running north 77° east to the line of the Commonwealth.

HARBOR IMPROVEMENTS BY THE GENERAL GOVERNMENT.

Boston Harbor.

In reporting upon the work done by the general government in the several harbors and waters of the Commonwealth, the Board regrets having to announce the loss of the services of two of the older and more distinguished officers of the United States Engineer Corps, who have long had charge of this work, and to whose personal knowledge, experience and interest much of its success has been due. The prompt and courteous attention with which they have uniformly responded to the requests of the Board for information and advice in matters relating to its work, has given additional value to the assistance rendered.

The death of Lieut. Col. G. K. Warren, Corps of Engineers, Brev. Maj. Gen. United States Army, occurred at Newport, R. I., his headquarters, on the 8th of August, 1882.

The contemplated retirement from active service of Lieut. Col. George Thom, Corps of Engineers, Brev. Brig. Gen. United States Army, will probably take place in February, 1883.

The public is not generally aware of the importance and magnitude of the works entrusted to the officers of the United States Engineers, of the accuracy of the examinations made, and of the care and thoroughness required in the execution of the work which enables a great ship to pass freely and safely over bars and ledges which were not only barriers to the entrance of our ports and harbors, but the hidden sources of danger and destruction.

During the last year, between the 20th of April and the 4th of December, 65,327 cubic yards of material have been removed from the "Anchorage Shoal" in the main basin of Boston Harbor, and the main ship channel has been thereby opened to a depth of 23 feet at mean low water, for an aggregate width of 1,000 feet at its easterly end, increasing to a width of 1,500 feet at its westerly end.

Repairs have been completed on the sea-walls of Gallop's Island, and of the north head of Long Island, and those on the sea-wall of Lovell's Island have been nearly finished.

In addition to, and in completion of, the work executed in 1881, the Mystic River has been improved by the dredging of an aggregate of 82,000 cubic yards, whereby the channel has been opened to a depth of 23 feet at mean low water, for a length of 2,930 feet, with a least width of 375 feet, and a greatest width of 435 feet.

No work has been done in the Charles River during the past year. There is now available, including the amount (\$67,500) appropriated by the River and Harbor Bill of August, 1882, a total of \$97,000 for the further improvement of this river.

In addition to the work reported last year, the width of Nantasket Beach Channel has been increased from 70 to 100 feet, and the sunken ledges near the mouth of Weir River broken up and removed, leaving a depth of $9\frac{1}{2}$ feet at mean low water.

By the River and Harbor Bill of August, 1882, the sum of \$96,500 was appropriated for the improvement of Boston

Harbor, \$67,500 of which was for the improvement of Charles River, as above stated, leaving \$29,000 to be applied to other works. Of this last amount about \$8,500 has been expended in the repairs of the sea-walls of the islands, before mentioned, and the remainder is to be applied next season to the repairs of the sea-walls of Great Brewster, Deer, Rainsford and Lovell's islands, and to the widening of the main ship channel at the western end of the Upper Middle Bar, in order to afford a more direct sailing course to vessels passing through the Anchorage Shoal Channel.

For completing the repairs on the sea-walls of the islands, and for all the other work hitherto projected for the improvement of this harbor, the sum of \$30,000 was asked in the last annual report of Gen. Thom to the Chief of Engineers.

The provision made by this Board during the past year, under a contract with the New England Dredging Company, already referred to, for receiving and depositing upon the South Boston flats all dredged material that might be offered, has given increased facility and economy to the work of the general government, as well as to that of the Commonwealth in the reclamation of the flats.

By the River and Harbor Bill of August, 1882, \$10,000 was appropriated for the improvement of Malden River, a tributary of the Mystic River. No work has yet been done under this appropriation.

The total amount appropriated by the general government for the improvement of the whole harbor, between March 2, 1867, and August 2, 1882, reaches the large sum of \$1,602,500, which has been expended in protecting the headlands of the harbor, removing dangerous obstructions, making an improved channel by which the largest ocean steamers have access to the inner port, and in deepening and enlarging the anchorage and navigable area of the inner basins.

Newburyport Harbor.

The revised estimate for the work of the general government, in charge of Gen. George Thom, of building the stone jetties at the mouth of this harbor, is \$465,000, instead of \$365,000, as reported last year. The appropriations already made amount to \$130,000. The northerly jetty is now built out, to its full height and width, a distance of about 1,500

feet from Salisbury Beach, and rubble stone has been deposited, for an additional distance of about 300 feet, along the axis of the jetty. The appropriation made August 2, 1882, \$40,000, is to be applied to the commencement of the southerly jetty at the northerly extremity of Plum Island, and to the building of a dike across the outlet of the "basin," in order to prevent the opening of a new channel from the sea through the basin into the harbor.

Merrimac River.

The work of the general government in this river has already been referred to in another part of our report.

Lynn Harbor.

A survey of this harbor was made by the general government in 1881, with a view to its improvement, and a plan of work to be done has been submitted to the Engineer Department, the estimated cost of which is \$270,000. By the River and Harbor Bill of August, 1882, the sum of \$60,000 was appropriated for this harbor.

In consequence, it is presumed, of the death of Gen. Warren and the resignation of Gen. Thom, a change has been made by the Engineer Department in the assignment of specific work, as well as in the *personnel* of the corps. By the courtesy of Major Franklin Harwood, U. S. Engineer, the Board has received a manuscript statement of the present condition and proposed improvement of Scituate, Plymouth, Provincetown, Hyannis and Wareham harbors, now under his charge; and also a printed copy of the report of work done in the same harbors, under the direction of Gen. Thom, for the fiscal year ending June 30, 1882, in substance as follows:—

Scituate Harbor.

The work done in this harbor, during the past year, has been the placing of about 10,000 tons of rubble stone in the breakwater, whereby its outer portion has been partially built for a length of about 470 feet, and to a height of about 3 feet above the plane of mean high water, with a thickness of about 10 feet on the top, so as to form a partial protection to the harbor.

Plymouth Harbor.

Forty-four thousand nine hundred and sixty-nine cubic yards of dredging have been done, in completion of the projected channel and basin in this harbor.

Gen. Thom further reports that, —

“All the works projected for the protection and preservation of Long Beach were completed in 1879. Some of these works (bulkheads and jetties) were built of crib-work about fifteen years ago, but owing to their exposed position at the outer end of the beach, and *particularly* to the unusually severe storms that occurred in February and March last, they have become much decayed and broken up, so much so that the beach has been much abraded, and weakened to such an extent as to render it liable to immediate destruction. The attention of the department was called to this matter in a special report, dated March 30, 1882, with a recommendation that Congress be requested to make an appropriation of \$14,000 for the purpose of extending the stone bulkhead along the western shore of the beach for an additional distance of 1,000 feet, so as to protect in a more permanent manner this the weakest part of the beach.

“With the unexpended funds available, 219 $\frac{1}{2}$ $\frac{44}{10}$ tons of rubble stone have been placed in the bulkhead during May and June, 1882; and it is proposed to apply the appropriation for the fiscal year ending June 30, 1883, to the continuation of this work.”

The later report and communication of Major Harwood to the Board, concerning the harbors of Provincetown, Hyannis and Wareham, with a further statement concerning Scituate and Plymouth harbors, will be found in the Appendix.

Nantucket Harbor.

The government work on the southern coast of the Commonwealth, which includes this harbor, was in charge of the late Gen. G. K. Warren, whose report, made June 30, 1882, gives the following statement of the progress of the work up to that date: —

At the date of the last annual report, the construction of the jetty, under contract dated December 28, 1880, was in progress.

During the fiscal year ending June 30, 1882, the work has been in progress under the same contract; 8,134 $\frac{1}{2}$ tons were placed in the work, which makes the total number of tons delivered 12,123 $\frac{7}{10}$, and leaves about 3,871 tons still to be furnished. The length of the jetty is about 1,650 feet.

During the year frequent surveys have been made to ascertain the effect of the work, and in May, 1882, a full survey of the outer harbor was made.

A comparison of the maps of these surveys shows a continuous deposit of sand in the west angle formed by the jetty and the shore. The high-water line at the jetty has advanced 150 feet. On the east side, in the early stages of the work, the sand was cut out, and in a severe storm from the north, on October 5, a considerable inroad was made on the shore immediately east of the work. To arrest this, short spurs were built at right angles to the jetty from near the shore out for 150 feet; since the building of these the sand has been deposited and the shore line advanced considerably, but not so much as on the west of the jetty.

The depth of water has increased over a considerable area between the jetty and the deep channel at Brant Point, while on the west side, from the outer end toward the shore, the depth has decreased. The current during ebb tide has increased, and it now flows northwestwardly out past the jetty; it is on this line that the increase in depth is noted

Edgartown Harbor.

The subject of the re-opening of the south beach of Cotamy Bay, and thus restoring the "south inlet" to Edgartown Harbor, which existed for many years prior to 1869, has been fully discussed by Gen. Warren, who has also given a history of the work done, with this end in view, in 1873; but his report is too voluminous to allow more than the following extracts, which refer to a proposed new opening at the south-western corner of this bay: —

The opening that was made in 1873, was made at the western end of the beach, under the belief that if it enlarged so as to become an inlet, it would gradually move eastward, and close as the last one had done. The western location thus promised a longer existence for the inlet.

The present location near the eastern end, would allow of but a comparatively short period, if the inlet formed and moved as the natural ones had done. It is therefore proposed to hold it in position by means of a jetty on the west side of the opening.

The width of the channel through the inside shoal, to allow the vessels in use to beat, need not exceed 200 feet. This is the greatest width of the existing channel. It will have to be widened in places, and considerably deepened in other places by dredging, to make 4 feet at mean low-water. To work the scows and tug, we shall have to make a depth of 6 feet, for a width of 60 feet, at mean low-water.

It does not now appear that the width of the beating channel need be any greater than 200 feet for the permanence of an inlet.

The wider, however, we can make the opening in the beach, the better

the chances of its becoming an inlet, and a cut 300 feet wide, 6 feet deep at mean low-water, is what is proposed, all to be done by dredging.

The place on the beach selected by the committee, is shown on the map near the former opening of 1846. It will be so marked off that the west side, or west chop (if it becomes an inlet), shall not be less than 500 feet from Chappaquiddick Island. This is the width of the narrowest natural inlet described by Mr. Whiting. That one we know succumbed in its battle with the waves and sands, but it sustained the contest alone, and it is proposed in the future to aid it in resisting encroachment in the best way we can.

Vineyard Haven Harbor.

By a resolution of Congress, passed January 24, 1882, Gen. Warren was required to ascertain the condition of this harbor, and whether any work is necessary for its protection.

In his report to the Chief of the United States Corps of Engineers, Gen. Warren discusses various projects for the improvement of this harbor, and gives the estimated cost of different breakwaters, ranging from \$1,250,000 to \$8,000,000.

In regard to the washing of the headlands of this important harbor, Gen. Warren says:—

The wearing away of the headland of "East Chop," [found by the Coast Survey, in 1871, to have been 75 feet in 15 years], is said to have continued since that time. The people who live in the vicinity have done a great deal to protect the bluff, and their efforts should undoubtedly be seconded by the general government. If the action is allowed to go on, it will not be long before the lighthouse will have to be removed.

To protect this headland will probably require that it be riprapped to above the highest waves. As a preliminary, I submit the following estimate:—

For protecting 5,000 feet of bluff would probably require	
40,000 tons of riprap, at \$1.50	\$60,000

Wood's Holl Harbor.

No work has been actually done in the improvement of this harbor during the last year; but surveys have been made for a pier and breakwater, the estimated cost of which is \$52,775. The following letter from Professor Spencer F. Baird, U. S. Commissioner of Fish and Fisheries, to General Warren, U. S. A., presents in a very full and interesting

manner the objects had in view in this work, and the value of the improvements proposed :

UNITED STATES COMMISSION, FISH AND FISHERIES,
WASHINGTON, D. C., December 17, 1881.

SIR:—I have the honor to enclose herewith a memorandum in reference to the importance of the proposed pier and breakwater in the Greater Harbor of Wood's Holl, Massachusetts, to the interests of navigation in general, and to those of the United States in particular.

Very respectfully, your obedient servant,

SPENCER F. BAIRD,
Commissioner.

Maj. Gen. G. K. WARREN, U. S. A.

[*Memorandum.*]

There are very few safe harbors, especially for vessels of over 10 feet draught, on the south coast of New England between Newport and Provincetown, the principal being Tarpaulin Cove on the island of Naushton, Wood's Holl, Vineyard Haven, Edgartown, Nantucket, and Hyannis, Provincetown being next in the series. Of these, the harbors of Tarpaulin Cove and Vineyard Haven are available only during the prevalence of certain winds, while those of Edgartown and of Nantucket (the bar of which can only be crossed at high tide and by low-draught vessels) are of insufficient depth, and very much out of the course of vessels. The harbor of Hyannis is formed simply by a breakwater in an open roadstead. In the range indicated, the Greater Harbor (as distinguished from a smaller) at Wood's Holl is by far the best, although access to it is somewhat difficult, in consequence of a narrow entrance. Here there is a depth of water ranging from 20 to 60 feet, which is ample for vessels of any class. No danger need be apprehended, except when heavy winds blow directly from the south, the quarter whence cyclone storms are very apt to come. The construction, however, of a pier or breakwater along either one of two shoals, making out directly from the mainland, would convert this harbor into an absolutely land-locked inclosure, under the shelter of which vessels might lie safe from any conceivable storm.

The United States Fish Commission, besides carrying on with success the reproduction of the shad, salmon, whitefish, and other useful freshwater fishes, has of late years been turning its attention to the multiplication of the fishes of the sea, from which results of the greatest importance are expected. Experiments made with the cod, Spanish mackerel, sea-bass, and striped bass have been entirely successful, and authorize the assurance of success in the application of the same principles to other species, such as the common mackerel, haddock, sheephead, tautog, weakfish, etc. The importance of arresting the very rapid diminution of these fish, and the still greater necessity of increasing their abundance to the extent within the power of applied science, make the selection of a station for carrying on this work on a large scale, a matter of greater moment. The requirements are a reasonably mild cli-

mate for the winter work, water perfectly pure and free from sewage, the aeration of this water, and accommodations for keeping the live fish for a certain time, with proper change of water and food during the interval. All this is, of course, contingent upon the occurrence of fish in considerable numbers and in proximity to seines and pounds, by which they may be taken alive and uninjured.

The method of procedure in the multiplication of these fish, is to catch the parent fish before the eggs are entirely ripe, bring them to the station in smacks or tow-cars, and transfer them to basins or floating cars, where they can be properly cared for. The eggs, when ripe, are then removed by well-known processes of manipulation. Sometimes weeks will elapse before the fish are ready to be "stripped," and, unless they have natural surroundings, they will suffer by the detention. In previous experiments of the United States Fish Commission, the fish were kept in large floating boxes or cars. In their attempts to pass through the gratings of these boxes, the fish were constantly receiving injuries, while the inclemency of the winter, during which the work was of necessity prosecuted, caused many to freeze to death before the operation was perfected.

It is contemplated to so construct the pier in question at Wood's Holl, that it shall inclose a number of subdivisions or basins, where the fish can be kept until ready for use. The passage of the tides through the openings between the mainland and the island of Naushon, causes an agitation of the water, whereby it is brought to the site of the proposed pier in a perfect foam, thus assuring the best possible conditions for the fish. It is confidently believed that at such a station there will be an opportunity to hatch out many hundreds of millions of eggs every year. A portion of the young fish would be turned out into the adjacent waters, and the remainder transferred by the vessels of the Fish Commission to points further south, possibly even to the Carolinas.

So far as the United States Fish Commission is concerned, this pier will also furnish a great desideratum in the way of a station at which its vessels can be kept, or can resort, when engaged in the prosecution of the practical investigations into the movements and abundance of the useful food-fishes.

Congress has thought fit to make an appropriation to the commission for the construction of a sea-going vessel of nearly 15 feet draught, whose explorations shall aid in the solving of many practical problems; at present, however, there is no available wharf on the south coast of New England (the best starting-point) to which this vessel can tie up for the purpose of taking on board supplies, etc., or delivering them on shore.

In addition to general service in the interest of commerce, and of the operations of the United States Fish Commission, this station will be available to other branches of the government service. It is particularly important for the Revenue Marine to enjoy the advantages afforded by such a station, and these the Fish Commission would be most happy to share with it. Four revenue cutters cruise on the south coast of New England, especially during the winter, and have constant occasion to

refit and take in coal, water, and other supplies. At the same time they require to be in close communication with the Treasury Department, and with the custom houses of Boston, New Bedford, Newport, etc. At present, their coaling and supplying station is at Edgartown, on an island, access to which is difficult and involves a delay of hours, especially in the winter season. No telegraph wires connect Edgartown with Boston, New Bedford, or Newport. If the principal station were established at Wood's Holl, in consequence of this improvement, the coal might be stored there; fresh water could be had directly at the wharf, and all necessary telegraph facilities obtained in the depot of the Old Colony Railroad, which is within a few hundred yards.

Other vessels of the government would likewise be benefited, especially those of the Light House Board. This board has a station in the "Little Harbor" at Wood's Holl, about half a mile from the proposed pier, which, however, its boats of large draught cannot enter, such vessels as the *Fern*, for instance, being obliged to anchor outside the harbor, instead of proceeding directly to the wharf to discharge or receive supplies of oil, etc.

PLANS APPROVED AND LICENSES GRANTED, DURING THE YEAR
1882, FOR THE ERECTION OF STRUCTURES IN AND OVER
TIDE WATER.

Nos.

651. Trustees under the will of Ebenezer Francis, for leave to change the mode of construction of Francis' Wharf, Fort Point Channel, as granted to them Nov. 28, 1881. Approved Jan. 5, 1882.
652. Joseph A. Bowen, for leave to straighten the southerly side of his wharf, known as the "Slate Wharf," in the City of Fall River. Approved Jan. 5, 1882.
653. William G. Brown, for leave to fill solid a portion of his wharf, known as the "Cob Wharf," on Ipswich River, in the town of Ipswich. Approved Feb. 2, 1882.
654. Trustees of the Harris Estate, for leave to extend Harris' Wharf in Boston Harbor to the Harbor Line. Approved Feb. 9, 1882.
655. Henry Howard, of New Bedford, for leave to construct a pile wharf in Onset Bay, in the town of Wareham. Approved March 16, 1882.
656. J. C. Kittredge, for leave to extend his wharf on First Street, South Boston. Approved March 16, 1882.
657. Benjamin D. Dixie, for leave to extend his wharf at Marblehead. Approved March 16, 1882.
658. Magee Furnace Company, for leave to extend its wharf on Marginal Street, Chelsea, to the Harbor Line. Approved March 23, 1882.
659. Henry L. Pierce, for leave to build a sea-wall in front of his land bordering on Neponset River, in the town of Milton, and fill solid the area enclosed by such wall. Approved March 23, 1882.
660. Abbie E. Cutter, Henry B. Cutter, and William O. Cutter, for leave to construct a wharf, partly solid and partly on piles, on the west side of Wickets Island, in Onset Bay, town of Wareham. Approved March 23, 1882.

Nos.

661. The Hingham, Hull and Downer Landing Steamboat Company, for leave to extend its wharf on piles, in the town of Hull. Approved April 12, 1882.
662. The White's Ferry Bridge Company, for leave to construct a bridge across North River, between the towns of Marshfield and Scituate. Approved April 5, 1882.
663. The Bradley Fertilizer Company, for leave to extend and maintain its present wharf on Weymouth Back River, in the town of Weymouth. Approved April 5, 1882.
664. Edward C. Ellis, for leave to construct a wharf on the south shore of Onset Bay, in the town of Wareham. Approved April 12, 1882.
665. The Standard Sugar Refinery, for leave to extend its wharf on Fort Point Channel, South Boston, on piles. Approved April 27, 1882.
666. The Old Colony Railroad Company, for leave to extend its wharf in Taunton River, at Somerset. Approved May 11, 1882.
667. County Commissioners of Essex County, for the construction of a part of Essex Merrimack Bridge, under chapter 104 of the Acts of the year 1882. Approved May 13, 1882.
668. South Boston Yacht Club, for leave to construct a pile wharf at City Point, South Boston, on the west side of Sixth Street. Approved May 18, 1882.
669. Trustees under the will of Augustus Hemenway, for leave to extend Howe's Wharf, on Fort Point Channel, to the Harbor Line. Approved May 18, 1882.
670. Joseph A. Bowen, for leave to extend "Slate Wharf" on its southerly side, in the City of Fall River. Approved May 18, 1882.
671. The Boston and Lowell Railroad Corporation, for leave to construct a sea-wall along the Harbor Line, west of its freight bridge across Charles River, in the City of Boston. Approved June 1, 1882.

Nos.

672. The Road Commissioners of the town of Quincy, for leave to fill solid a part of Neponset Bridge. Approved May 25, 1882.
673. Stephen M. Weld of Dedham, for leave to construct two breakwaters in Buzzard's Bay, in the town of Wareham. Approved May 25, 1882.
674. The City of Gloucester, for leave to build a highway, in line of Washington Street, across the Mill Pond. Approved June 1, 1882.
675. Samuel Elliott, for leave to extend his wharf on Merrimack River at Haverhill. Approved June 8, 1882.
676. Worin Tasker, for leave to extend his wharf on Merrimack River at Haverhill. Approved June 8, 1882.
677. John E. Gale, for leave to extend his wharf on Merrimack River at Haverhill. Approved June 8, 1882.
678. James R. Nichols, for leave to extend his wharf on Merrimack River at Haverhill. Approved June 8, 1882.
679. W. R. Whittier, for leave to extend his wharf on Merrimack River at Haverhill. Approved June 15, 1882.
680. Albert L. Kimball, for leave to extend his wharf on Merrimack River at Haverhill. Approved June 15, 1882.
681. Goodrich and Porter, for leave to extend their wharf on Merrimack River at Haverhill. Approved June 15, 1882.
682. Trustees under the will of Augustus Hemenway, for leave to build a sea-wall and fill solid at Howe's Wharf, so called, on Fort Point Channel, Boston. Approved June 22, 1882.
683. Jesse Tirrell, for leave to construct a sea-wall and fill solid at his wharf on Fort Point Channel, Boston. Approved June 22, 1882.
684. Benjamin Montgomery, for leave to extend his wharf in Gloucester Harbor. Approved June 22, 1882.
685. George Dennis, for leave to extend his wharf in Gloucester Harbor. Approved June 22, 1882.

Nos.

686. B. F. Wild & Co., for leave to drive a row of piles for the protection of their wharf on Mystic River. Approved June 29, 1882.
687. County Commissioners of Essex County, for a change in the construction of the Essex Merrimack Bridge, between the towns of Newbury and Salisbury, over Merrimack River. Approved July 6, 1882.
688. Moseley and Potter, for leave to drive piles for the support of a water-tank on Congress Street Bridge, Fort Point Channel, Boston. Approved July 6, 1882.
689. Jesse Tirrell, for leave to extend his wharf to the Harbor Line on Fort Point Channel, Boston. Approved July 13, 1882.
690. Amos A. Story, for leave to extend his wharf, partly solid and partly on piles, in Gloucester. Approved July 20, 1882.
691. Reed and Gamage, for leave to extend their wharf in Gloucester Harbor. Approved July 20, 1882.
692. Standard Fertilizer Company, for leave to construct a wharf in Duxbury Bay. Approved Aug. 3, 1882.
693. Board of Directors of the East Boston Ferries, for leave to extend and reconstruct its Piers on the Boston side of the North Ferry. Approved Aug. 10, 1882.
694. J. H. Durgin, for leave to extend his wharf on Merrimack River at Haverhill. Approved Aug. 10, 1882.
695. Charles W. and R. Stuart Chase, for leave to extend their wharf on Merrimack River at Haverhill. Approved Aug. 10, 1882.
696. A. H. Adams, for leave to extend his wharf on Merrimack River at Haverhill. Approved Aug. 10, 1882.
697. Eastern Railroad Company, for the reconstruction of the draw-pier in its bridge across Merrimack River at Newburyport. Approved Aug. 10, 1882.
698. City of Haverhill, for leave to extend City Landing No. 10 on Merrimack River. Approved Aug. 31, 1882.

Nos.

699. George A. Green, for leave to extend his wharf on Merrimack River at Haverhill. Approved Aug. 31, 1882.
700. John P. Gilman, for leave to extend his wharf on Merrimack River at Haverhill. Approved Aug. 31, 1882.
701. John D. Hillard, for leave to extend his wharves at Provincetown. Approved Sept. 14, 1882.
702. Thomas R. Whorf, for leave to extend and widen his wharf at Provincetown. Approved Sept. 14, 1882.
703. The Boston and Hingham Steamboat Company, for leave to construct a dolphin in Chelsea Creek. Approved Oct. 12, 1882.
704. S. S. Swift, for leave to extend his wharf in Provincetown Harbor. Approved Oct. 12, 1882.
705. City of Boston, for leave to extend the southerly pier of the East Boston South Ferry, East Boston. Approved Oct. 13, 1882.
706. Onset Bay Grove Association, for leave to extend its wharf at Onset Bay, Wareham. Approved Nov. 2, 1882.
707. Edward P. Shaw, for leave to construct a wharf at Salisbury Point, near Badger's Rocks, on Merrimack River. Approved Nov. 16, 1882.
708. Naumkeag Steam Cotton Company, for leave to drive a line of piling for the foundation of a sea-wall on South River, Salem Harbor. Approved Nov. 23, 1882.
709. Edward P. Shaw, for leave to construct a wharf on the northwesterly end of Plum Island, on Merrimack River, at Newburyport. Approved Nov. 23, 1882.
710. Nantucket Railroad Company, for leave to construct a solid roadway across tide-water in Nantucket Harbor. Approved November 23, 1882.
711. County Commissioners of Essex County, for the reconstruction of the draw and draw pier, in Rocks Bridge, across Merrimack River, between Haverhill and West Newbury. Approved Dec. 1, 1882.

Sixty-one licenses have been granted. Applications for others, which the Board has felt obliged to refuse, have perhaps occupied quite as much of its time, and occasioned more study and perplexity. In all cases, a careful examination of the localities and plans of the works proposed, has been made by the Board and its Engineers.

ARCHIVES OF MAINE LANDS.

This Board, under various legislative acts, has succeeded to the powers and duties of the former Land Agents of the Commonwealth,— among which is the custody of the records of lands once held and conveyed by Massachusetts, and now within the limits of the State of Maine. By chapter 58 of the Resolves of 1873, a portion of these records was transferred to the latter State; and the records of Maine lands granted as bounties to revolutionary soldiers and their heirs, have always been in the custody of the Secretary of this Commonwealth. This Board is still responsible for the safe keeping of seven volumes of records of conveyances by this Commonwealth of lands in Maine, one volume of the like records of lands in Madawaska, one volume containing the plans and records of the drawings of the “ Lottery Lands,” so called, in the easterly section of Maine, and an old account book, containing a record of the receipts and disbursements of the Land Agents on account of the above lands, from the year 1823 to the year 1853.

These records, apart from their historical interest, have no present value except as furnishing evidence of title to lands in another State; and record copies, to have legal effect, must be certified by the Secretary of the Commonwealth. As a matter of fact, most of the above volumes are now, for convenience in the investigation and proof of titles, in the Secretary's office, this Board holding his receipt therefor; and it is respectfully recommended that all the archives of Maine lands be placed by law in the charge and custody of that officer, to be kept in his office.

JOHN E. SANFORD.
FRANCIS A. NYE.
HENRY L. WHITING.

APPENDIX.

APPENDIX.

[1.]

[See page 5 of this Report, *ante*.]

AGREEMENT BETWEEN THE COMMONWEALTH AND THE BOSTON & ALBANY RAILROAD COMPANY ACTING BY THE NEW YORK & NEW ENGLAND RAILROAD COMPANY.

KNOW ALL MEN BY THESE PRESENTS, That

WHEREAS, by an agreement between the Boston & Albany Railroad Company and the New York & New England Railroad Company, made on the fifteenth day of July, A. D. 1880, and recorded with Suffolk Deeds, Lib. 1568, Fol. 45, to which reference may be had as if fully recited herein, said Boston & Albany Railroad Company agreed, upon and after a full performance by said New York & New England Railroad Company of each and all of its agreements thereby made, to release to it all the right, title and interest which said Boston & Albany Railroad Company had or could have, under and by virtue of any agreements theretofore made by it with the Commonwealth of Massachusetts, in or to any lands or flats in that part of Boston called South Boston, in said Commonwealth of Massachusetts, which said Commonwealth had theretofore agreed to convey to it, subject to all the terms, provisions and conditions of each and all of said agreements; and that said New York & New England Railroad Company might act as the attorney of said Boston & Albany Railroad Company, and in its name and behalf enforce, defend or settle any legal right, claim or liability of or against it under said agreements, or in regard to or in connection with said lands or flats, except as therein excepted, but only at the cost and expense of said New York

& New England Railroad Company, and without increasing or creating any liability of said Boston & Albany Railroad Company ;

AND WHEREAS, said Commonwealth, acting by its Board of Harbor and Land Commissioners, with the approval of its Governor and Council, and to the satisfaction of said Board, of the one part, and said New York & New England Railroad Company, and said Boston & Albany Railroad Company acting by said New York & New England Railroad Company as its attorney under the authority and power aforesaid, of the other part, have mutually agreed upon a full settlement, on the terms hereinafter set forth and agreed upon, of all matters, claims and demands asserted in the suit at law now pending in the Superior Court in and for the County of Suffolk, in said Commonwealth, or in the proceedings in equity now pending in the Supreme Judicial Court in and for said County of Suffolk, commenced against said Boston & Albany Railroad Company in pursuance of chapter fifty (50) of the Resolves passed by the General Court of said Commonwealth of Massachusetts in the year eighteen hundred and eighty (1880), or arising under or by virtue of all or any of the stipulations, agreements or provisions contained or made in or by said agreements between said Boston & Albany Railroad Company and said Commonwealth ;

NOW, THEN, IT IS HEREBY AGREED, on this first day of August, in the year 1882, by and between said Commonwealth, party hereto of the first part, and said New York & New England Railroad Company, and said Boston & Albany Railroad Company acting as aforesaid, party hereto of the second part, as follows, namely :

That the total sum or sums of money due or payable to said Commonwealth from said Boston & Albany Railroad Company, or from said New York & New England Railroad Company, on account of any or all of said matters, claims or demands, or under all or any of said agreements, including all principal, interest, damages and liabilities of every name and nature, is the sum of one hundred thousand dollars, and no more, with interest at the rate of five per centum per annum from the first day of May, in the year 1882.

And said New York & New England Railroad Company agrees with said Commonwealth, that said company will

(I.) Before or at the expiration of ten (10) years from and after the said first day of May, A. D. 1882, pay to said Commonwealth said sum of \$100,000, with interest from and after said first day of May at the rate of five per centum per annum, payable semi-annually on the first days of May and November in each year; and will accept instead of, and as and for a conveyance of the land which said Commonwealth in and by said agreements agreed to convey to said Boston & Albany Railroad Company, a conveyance in fee simple, free from all incumbrances except as hereinafter stated, of all that parcel of land situated in said South Boston, bounded and described as follows:

Beginning at the southerly corner of said parcel, at the intersection of the south-westerly side-line of Congress Street as located and laid out by the Board of Street Commissioners for the City of Boston, March 14, 1879, with the north-westerly side-line of "B" Street; thence running north $40^{\circ} 59' 59''$ east, along the north-westerly side-line of said "B" Street, seven hundred and ninety-one and fifty-seven one-hundredths ($791\frac{57}{100}$) feet; thence running north $30^{\circ} 06' 28''$ east, and bounded south-easterly by other land of the Commonwealth, one thousand five hundred and twenty-three and sixteen one-hundredths ($1,523\frac{16}{100}$) feet; thence north $61^{\circ} 01' 04''$ west, eight hundred and twenty-two and ninety-four one-hundredths ($822\frac{94}{100}$) feet; thence, on the arc of a curve of two thousand three hundred and seventy (2,370) feet radius, to which the said last-described line is tangent at its westerly end, one hundred and sixteen and seventy-three one-hundredths ($116\frac{73}{100}$) feet, more or less, to the dividing line, wherever it may be, between the land hereby agreed to be conveyed and other land known as the 25-Acre Lot, heretofore agreed to be conveyed by the said Commonwealth of Massachusetts to the said New York & New England Railroad Company, in accordance with the provisions of chapter two hundred and sixty (260) of the Acts of the General Court of Massachusetts for the year 1880. The course of a straight line which connects the ends of said last-described curved line is north $62^{\circ} 25' 44''$ west,

and its length is one hundred and sixteen and seventy-one one-hundredths ($116\frac{71}{100}$) feet, more or less. Thence continuing south $30^{\circ} 07' 50''$ west, along the said division line, and bounded north-westerly by the said 25-Acre Lot, one thousand and three hundred and seventeen and four-tenths ($1,317\frac{4}{10}$) feet, more or less; thence south $55^{\circ} 48' 31''$ east, and bounded south-westerly by land of the Boston Wharf Company, seventy and ninety-six one-hundredths ($70\frac{96}{100}$) feet, more or less, to a point which is on a south-easterly extension of the straight boundary line on the south-westerly side of the land hereinbefore referred to as to be conveyed in accordance with the terms of chapter 260 of the Acts of the General Court of Massachusetts for the year 1880, and is distant ninety-seven and fifty-seven one-hundredths ($97\frac{57}{100}$) feet from a copper bolt in a stone bound on the said boundary line, and is also distant one thousand and ninety-three (1,093) feet from the intersection of said south-westerly boundary line of said 25-Acre Lot with the harbor line on the easterly side of Fort Point Channel, as defined by chapter thirty-five (35) of the Acts of the General Court of Massachusetts for the year 1840; thence south $30^{\circ} 01' 35''$ west, and bounded north-westerly by land of the Boston Wharf Company and by Congress Street, eight hundred and eighteen and forty-five one-hundredths ($818\frac{45}{100}$) feet to a point in the south-westerly side-line of Congress Street hereinbefore referred to; thence south $49^{\circ} 00' 01''$ east, along the south-westerly side-line of said Congress Street, and bounded south-westerly by land of the Boston Wharf Company and other land known as the 12-Acre Lot, heretofore agreed to be conveyed by the said Commonwealth of Massachusetts to the said New York & New England Railroad Company, seven hundred and thirty-one and fifty-six one-hundredths ($731\frac{56}{100}$) feet to the point of beginning,—containing by estimation 1,976,654 square feet, more or less. For a more particular description, reference may be had to the accompanying plan.* Intending to include in the foregoing description all the land lying between, and bounded by, the exterior north-easterly line set forth in the accom-

* The plan referred to is on file in the offices of the Secretary and the Treasurer of the Commonwealth, and of this Board.

panying plan, the parcel of land known as the 25-Acre Lot described in chapter 260 of the Acts passed by the General Court of said Commonwealth in the year 1880, land of the Boston Wharf Company, the parcel of land described in said chapter as “a parcel of land and flats containing twelve acres, more or less,” “B” Street, so called, and a line running south $30^{\circ} 06' 28''$ west, one thousand five hundred and twenty-eight and sixteen one-hundredths ($1,528\frac{16}{100}$) feet from said exterior line to the point where said line intersects with the northerly line of “B” Street. All bearings or courses stated in the foregoing description, are to be referred to the meridian $71^{\circ} 00' 54.883''$ west longitude.

Said conveyance to be subject to any rights which the City of Boston may have acquired in Eastern Avenue or Congress Street, and to any obligations of the Commonwealth, under the agreements and indenture next hereinafter mentioned, in relation thereto; and to be subject to the rights as to the laying out of Northern Avenue, or of any drains or sewers on, over or in said parcel of land hereinbefore described, and said to contain by estimation 1,976,654 square feet, more or less, which are reserved to said Commonwealth and to the City of Boston in and by agreements between said Commonwealth and said Boston & Albany Railroad Company, dated on the eighth day of December, A. D. 1869, and on the twenty-fourth day of June, A. D. 1873, or in and by an indenture of four parts between said Commonwealth of the first part, said Boston & Albany Railroad Company of the second part, the Boston Wharf Company of the third part, and said City of Boston of the fourth part, dated on said twenty-fourth day of June, 1873, except so far as the rights so reserved to said Commonwealth are modified by express provisions of this agreement; and to be subject to any obligations of said Commonwealth, under said agreements and indenture, in relation to said parcel of land or any portion thereof.

And said New York & New England Railroad Company further agrees with said Commonwealth, that said Company will

(II.) Proceed forthwith to perform with all practicable

despatch all the filling and other work which said Commonwealth is now entitled to have performed by said Boston & Albany Railroad Company upon or in relation to said parcel of land, which filling and other work is agreed by the parties hereto to be the following only and no more ; that is to say :

(1) Fill with solid filling, to the grade of sixteen feet above mean low water, the area on the accompanying plan within a line drawn from *a* to *b* to *c* to *d* to *e* to *g* to *h* to *i* to *j* to *k* to *l* to *m* to *n* to *a*, the place of beginning. If the filling of said area along said line, from *l* to *m* to *n*, shall not be done in such time and manner as to protect the filling of the adjoining territory by said Commonwealth, then the said New York & New England Railroad Company shall, on demand, pay to said Commonwealth the actual cost of all material deposited by said Commonwealth on said adjoining territory, which may flow or form a slope upon said area along said line. The area bounded by and within a line beginning at point *e*, thence to *o*, thence to *p*, thence to *g*, thence to point *e*, the place of beginning, is for the present reserved for a dock : provided, that said company shall have the right, at any time within twenty-five (25) years from the date of this agreement, to fill said last-described area and build the sea-walls around said area so far as indicated on the accompanying plan, the work of filling and of building the said wall to be done in such way as shall be approved by said Board of Harbor and Land Commissioners ; but if said company does not within said twenty-five (25) years exercise said right of filling said last-described area, it shall be taken to have elected to have reserved the same for a dock.

(2) Complete the wall on Pier Number four (4) as shown on the accompanying plan, in such way as shall be approved by said Board of Harbor and Land Commissioners.

And said Commonwealth on its part agrees with said New York & New England Railroad Company, that said company shall be permitted to pay all or any part of said sum of \$100,000 at any time within the period of ten years aforesaid, after ten (10) days' notice of its intention so to do, with the interest accrued on the part so paid up to the date of such payment ; and that, upon the payment to said

Commonwealth by said New York & New England Railroad Company, or by said Boston & Albany Railroad Company, of the whole of said \$100,000 with the interest accrued thereon, or upon the giving of such security therefor as said Commonwealth, by its officers or agents hereafter duly authorized so to do, shall accept as satisfactory, said Commissioners not declaring that they have any authority so to accept, and upon the due performance of the filling and other work which said New York & New England Railroad Company is bound to do as aforesaid, and of all acts and things, other than filling or work or payment of money, which either of said Railroad Companies is bound to do, under the aforesaid agreements and indenture as modified by these presents, prior to the conveyance of said parcel of land by said Commonwealth, said Commonwealth, under the aforesaid agreements and indenture as modified by these presents, will convey by a good and sufficient warranty deed to said Boston & Albany Railroad Company, or to such grantee or assignee as the said Boston & Albany Railroad Company shall in writing designate or appoint, or to said New York & New England Railroad Company, upon the due execution and delivery of the release which said Boston & Albany Railroad Company, by the agreement first herein referred to, agrees, as therein stated, to give to said New York & New England Railroad Company, all said parcel of land, and all the land which as aforesaid the said foregoing description is intended to include, free from and of all incumbrances except as aforesaid.

And whereas Northern Avenue, so called, may be hereafter so laid out over said parcel of land that, by reason of the provisions of the agreements or indenture next hereinafter mentioned, said Boston & Albany Railroad Company or New York & New England Railroad Company may not be entitled to compensation therefor; and whereas the cost, at the rates hereinafter specified, of the portions of said parcel which may be so taken for said Northern Avenue, is included in said sum of \$100,000, and, in case of the laying out of said Northern Avenue without compensation for the reason aforesaid, ought not to be claimed or retained by said Commonwealth:

Now, then, the said Commonwealth doth further agree that, if and when said Northern Avenue is or shall be so laid out, whether by said Commonwealth or by the City of Boston, under the provisions of the aforesaid agreements of December 8, 1869, and June 24, 1873, or of the aforesaid indenture of June 24, 1873, over said parcel or any part thereof, provided, it is so laid out by said Commonwealth or said City of Boston in the due exercise of the rights reserved or given by said agreements or indenture, and in such manner and within such time, that said Commonwealth or City of Boston is not bound to make such compensation and does not incur any liability for land damages for so doing, said Commonwealth will deduct from said \$100,000, or credit on said \$100,000, the amount of the cost, at the rate of fifty (50) cents per square foot, of all that portion of the land hereby agreed to be conveyed which shall be included within said Northern Avenue as so laid out, and which lies between the boundary line dividing said land from the 25-Acre Lot, so called, as said line is shown on the accompanying plan, (described as S. 30° 07' 50" W. 1317.40 feet, more or less,) and a line drawn parallel to, and distant seventy and seventy-eight one-hundredths ($70\frac{78}{100}$) feet south-easterly from, said boundary line, and of the cost, at the rate of twenty (20) cents per square foot, of any other portions of said land so included within said Northern Avenue, with interest at five (5) per centum per annum from and after the first day of May, 1882, on said amount, or repay the same amount and interest, if already paid to it, to that one of said companies which shall have paid the same. And said Commonwealth on its part hereby releases to said Boston & Albany Railroad Company and to said New York & New England Railroad Company, all right which it has by virtue of the aforesaid agreement of December 8, 1869, to lay out said Northern Avenue on or over said parcel of land or any part thereof, at any time after two years after the filling and other work, hereinbefore stipulated to be done, has been completed, and written notice thereof given to said Commonwealth.

And in consideration of the premises, and of the sum of \$330,000 heretofore paid by said Boston & Albany Railroad

Company to said Commonwealth, said Commonwealth hereby releases and discharges said Boston & Albany Railroad Company of and from all debts, claims, demands, liabilities or obligations to or for the payment or performance of money, damages, filling, or other work, or any other matters or things arising under or by virtue of said agreements made by said Boston & Albany Railroad Company with said Commonwealth, or by reason of any breach thereof, and accepts said New York & New England Railroad Company in the place of said Boston & Albany Railroad Company, with all the rights and subject to all the liabilities which said Boston & Albany Railroad Company would have or be liable to under said agreements as modified by these presents, except that said Commonwealth agrees not to make to said New York & New England Railroad Company the conveyance aforesaid, except upon and after the full performance by it of all its agreements made in and by said first herein mentioned agreement of July 15, 1880, or upon the written request or with the written consent thereto of said Boston & Albany Railroad Company; and said Boston & Albany Railroad Company, acting as aforesaid by said New York & New England Railroad Company, doth hereby release, acquit, and discharge said Commonwealth of and from all claims and demands under said agreements for the conveyance to it, the said company, of any land situated in said South Boston, except said parcel of land and except the land which as aforesaid said foregoing description is intended to include.

And said Commonwealth and said Boston & Albany Railroad Company, acting as aforesaid by said New York & New England Railroad Company, and said New York & New England Railroad Company for itself, mutually accept these presents as a full accord and satisfaction of all claims and demands arising under any previous agreements relative to the subject-matters aforesaid.

IN TESTIMONY WHEREOF, on this first day of August, in the year 1882, the said Commonwealth of Massachusetts, acting by its Board of Harbor and Land Commissioners, hath caused its corporate seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf, and the same to be approved by its Governor and Council;

and the said New York & New England Railroad Company, acting for itself, and as the attorney of the said Boston & Albany Railroad Company, by James H. Wilson, its president, thereunto duly authorized by vote of its directors, a copy of which vote is hereunto annexed, hath hereunto set its corporate name and seal; and the said Boston & Albany Railroad Company, by William Bliss, its president, thereunto duly authorized by vote of its directors, a copy of which vote is hereto annexed, in token of its assent to the provisions of the foregoing agreement, hath hereunto set its corporate name and seal.

COMMONWEALTH OF MASSACHUSETTS,

By JOHN E. SANFORD,	} <i>Harbor and</i>	[SEAL OF THE COMMONWEALTH.]	
FRANCIS A. NYE,			<i>Land</i>
HENRY L. WHITING,			<i>Commissioners.</i>

NEW YORK & NEW ENGLAND RAILROAD COMPANY,

By JAMES H. WILSON, <i>President.</i>	[SEAL OF N. Y. & N. E. R. R. CO.]
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BOSTON & ALBANY RAILROAD COMPANY,

By NEW YORK & NEW ENGLAND R.R. Co., its Attorney,
By JAMES H. WILSON, *President.*

BOSTON & ALBANY R. R. CO.,

By WILLIAM BLISS, <i>President.</i>	[SEAL OF B. & A. R.R. CO.]
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BOSTON, December 26, 1882.

At a meeting of the Directors of the New York & New England Railroad Company, held December 22, 1882, the following vote was passed:—

“A draft of a proposed agreement of settlement between this Company, as the attorney of the Boston & Albany Railroad Company, under the agreement between the Boston & Albany Railroad Company and this Company, dated July 15th, 1880, and the Commonwealth of Massachusetts, by which it is agreed that all liabilities shall be compromised for the sum of one hundred thousand dollars (\$100,000), with interest at five (5) per cent. from May 1st, 1882, was submitted by the General Solicitor of this Company; and, on motion of Mr. Hart, it was

“*Voted*, That the President of the Company be, and he hereby is, authorized, in its name and behalf, to sign its corporate name and set its common seal to the instrument which has just been submitted, dated the first (1st) day of August, 1882; provided, however,

that any modification in the details of said agreement, which may be deemed necessary or proper by the President and General Solicitor, may be made before the execution thereof."

A true copy from the record,

Attest:

[SEAL OF THE N. Y. &
N. E. R. R. CO.]

JAMES W. PERKINS,
Clerk of Board of Directors.

Boston, December 26, 1882.

We hereby certify that the foregoing instrument is the instrument submitted to the Directors of the New York & New England Railroad Company, at their meeting held December 22d, 1882, and referred to in the appended copy of vote passed at said meeting, with slight verbal changes approved by us.

JAMES W. WILSON,
President of N. Y. & N. E. R. R. Co.

WILLIAM CALEB LORING,
General Solicitor of N. Y. & N. E. R. R. Co.

Boston, January 3, 1883.

At a meeting of the Board of Directors of the Boston & Albany Railroad Company, duly held in the city of Boston this third day of January, A. D. 1883, the following vote was passed:—

Whereas, The Counsel of the Corporation has examined the proposed agreement of settlement of the controversy between the N. Y. & N. E. R. R. Co. and the Commonwealth of Massachusetts, relative to the South Boston Flats, and approves of the same,

Voted, That the President be authorized to consent to the same in writing in behalf of the corporation.

J. A. RUMRILL,
Secretary and Clerk.

COMMONWEALTH OF MASSACHUSETTS.

Boston, January 4, 1883.

Approved by the Governor and Council.

HENRY B. PEIRCE,
Secretary of the Commonwealth.

SECRETARY'S DEPARTMENT,
Boston, January 12, 1883.

[2.]

AGREEMENT BETWEEN THE BOSTON & ALBANY
RAILROAD COMPANY AND THE NEW YORK & NEW
ENGLAND RAILROAD COMPANY, REFERRED TO IN
THE PRECEDING AGREEMENT.

Memorandum of an Agreement, made this fifteenth day of July, A. D. 1880, by and between the Boston & Albany Railroad Company and the New York & New England Railroad Company.

Said Boston & Albany Railroad Company hereby, pursuant to the authority given it by St. 1869, ch. 461, and all other powers it has in the premises, agrees, upon and after a full performance by said New York & New England Railroad Company of each and all of its agreements hereby made, to release to it all the right, title and interest which said Boston & Albany Railroad Company has, or can have, under and by virtue of any agreements heretofore made with it by the Commonwealth of Massachusetts, in or to any lands, or flats, situate in that part of Boston, in said Commonwealth, called South Boston, which said Commonwealth has heretofore agreed to convey to it, subject to all the terms, provisions and conditions of each and all of said agreements.

And said New York & New England Railroad Company hereby agrees to pay to said Boston & Albany Railroad Company, forthwith, the sum of thirty thousand dollars, with interest at the rate of six per cent. per annum from and after the seventh day of February, A. D. 1879, and the sum of three hundred thousand dollars within ten years from said day, with interest thereon until paid, payable semi-annually on the first days of January and July of each year, at the rate of two per cent. per annum for the first five years, and at the rate of four per cent. per annum for the

next five years; and also to do, pay and perform all acts, work, moneys, interest, damages, matters and things of any kind or description whatever, which said Boston & Albany Railroad Company has agreed, or was, is now, or may or can hereafter be, legally bound or required to do, pay or perform, either by, under or in consequence either of, or of any breach of, all or any part or clause of any agreement or agreements heretofore made by it with said Commonwealth, or any other person or corporation, for or in relation to said lands or flats, or any work or materials already or to be done or furnished to, for, upon, in relation to, or in connection with said lands or flats, or as owning or interested in said lands or flats, or any part thereof; excepting work or materials in fact done or furnished before the tenth day of September, A. D. 1878, or moneys heretofore paid by it to said Commonwealth.

Said New York & New England Railroad Company may occupy and use said lands and flats if, and so long only as, it shall fulfil and perform its agreements hereby made; and may act as the attorney of said Boston & Albany Railroad Company, and, in its name and behalf, enforce, defend or settle any legal right, claim or liability of or against it under said agreement or agreements, or in regard to or in connection with said lands or flats, except as aforesaid, but only at the cost and expense of the said New York & New England Railroad Company, and without increasing or creating any liability of said Boston & Albany Railroad Company; and hereby agrees to pay all reasonable expenses, including counsel fees, incurred by said Boston & Albany Railroad Company in defending or resisting any such claim or liability of or against it under said agreement or agreements, or in regard to or in connection with said lands or flats, except as aforesaid, and to pay or indemnify it against all taxes and assessments assessed after the seventh day of February, A. D. 1879, on said lands or flats, or any part thereof.

In witness whereof, said Boston & Albany Railroad Company, and said New York and New England Railroad Company, each by its respective President, thereto duly authorized, has hereto signed its corporate name and set its com-

mon seal, on this fifteenth day of July, in the year eighteen hundred and eighty.

THE BOSTON & ALBANY R. R. CO.,

By WM. BLISS, *President*. [CORPORATE SEAL.]

NEW YORK & NEW ENGLAND RAILROAD CO.,

By WM. T. HART, *President*. [CORPORATE SEAL.]

Signed, sealed and delivered in presence of

CHAS. F. WALCOTT,

To execution by B. & A. R. R. Co.

G. W. BALDWIN,

To execution by N. Y. & N. E. R. R. Co.

[3.]

[See page 4 of Report, *ante*.]CONTRACT OF THE COMMONWEALTH WITH THE
NEW ENGLAND DREDGING COMPANY.

Articles of Agreement, made this first day of July, in the year eighteen hundred and eighty-two, by and between the New England Dredging Company, a corporation established under the laws of Massachusetts, party of the first part, and the Commonwealth of Massachusetts, acting by its Board of Harbor and Land Commissioners, party of the second part.

Said party of the first part hereby covenants and agrees to furnish all the plant, tools, appliances and labor necessary to receive, store, elevate and deposit, as hereinafter provided, all the material, except rocks, stones and sewage matter, dredged in and about Boston Harbor, for which a dumping-ground is desired, or may be assigned by the Board of Harbor and Land Commissioners.

Said party of the first part may locate the dumping-ground and elevating station for said material, between the elevating station now used by said party in executing its contract with said party of the second part, dated August twelfth (12th), eighteen hundred and eighty-one (1881), and the bulkhead extending northerly from the southerly line of Eastern Avenue on a line parallel with and fifty feet east of the easterly line of C Street extended, or in any other location approved by said Board of Harbor and Land Commissioners; and the same shall be of sufficient capacity to accommodate and dispose of all the material offered.

The approach to said dumping-ground shall be kept free and easy of access for scows and tow-boats to bring material thereto at or near high water, and, should it be necessary to excavate a channel for that purpose, the said Board of Harbor and Land Commissioners may require, and by their engineer direct, the party of the first part to dredge the same, the material so dredged to be deposited in accordance

with, and accepted as part performance of, the aforesaid contract dated August twelfth (12th), eighteen hundred and eighty-one (1881), and the channel so excavated, and the necessary space excavated around the elevating station, to be refilled, upon the expiration of this contract, or the abandonment of said station before that time, to its present level, by said party of the second part.

The two elevating stations aforesaid shall be separated by a substantial bulkhead, to be built by said party of the first part, of such dimensions and construction as shall be approved by the engineer of said Board of Harbor and Land Commissioners.

All the material offered as aforesaid shall be elevated, conveyed and deposited, between the present surface and grade thirteen (13), on the area lying between the southerly boundary of the area to be filled by said party of the first part under the aforesaid contract dated August twelfth (12th), eighteen hundred and eighty-one (1881), and the southerly line of Cipher Street, so called, and between B Street and a line one hundred feet east of and parallel with D Street extended, in such places and in such order, working from said B Street easterly, as is consistent with a systematic and practicable arrangement of tramways, to be constructed by said party of the first part for that purpose; but said party of the second part reserves the right to fill, or cause to be filled by other parties, a strip along the southerly side of said area, not exceeding three hundred feet in width, without prejudice to the right of said party of the first part to be paid for material deposited under this contract and flowing upon said strip.

In all work under this contract, the lines, grades and instructions, not inconsistent with the provisions hereof, of the engineer of said Board of Harbor and Land Commissioners, shall be strictly observed, and all necessary aid and materials for giving and indicating said lines and grades, shall be furnished by said party of the first part.

All the work aforesaid shall be done to the reasonable satisfaction of said engineer, from time to time, during the progress and until the completion and acceptance of said work. The material deposited shall be left smooth and

level at grade thirteen (13), except in such places as may be only partially filled at the expiration of this contract, and, where the boundaries are unprotected, the filling may take its natural slope.

Said party of the second part hereby covenants and agrees to pay said party of the first part, for the work aforesaid, at the rate of twenty-five cents for each cubic yard, as measured in the fill, of material received, stored, elevated and deposited as aforesaid.

Monthly estimates of the work done shall be made by the engineer in charge, and monthly payments made of seventy-five per cent. of the contract price for all such material above grade thirteen (13), and ninety per cent. of the contract price for all such material below grade thirteen (13).

When an area has been graded level at grade thirteen (13), or at such grade as shall be thought necessary to allow for settling to said grade, payment shall be made of ninety per cent. of the contract price for all such material on said area up to grade thirteen (13), the remaining ten per cent. to be retained until the final completion and acceptance of the work, or the expiration of this contract.

When the area filled from one tramway has been levelled and maintained at grade thirteen (13) for one month, such area shall be accepted as to grade, and the contractor relieved of further responsibility for the same.

Upon all questions of measurements, lines or grades, proposed in writing by one party, the decision of the engineer of said Board, after notice to the other party, shall be final.

This agreement shall expire on the eighteenth (18th) day of August, eighteen hundred and eighty-four (1884), and, if said party of the first part shall refuse or neglect to prosecute the work herein contracted for, or in any other substantial respect shall violate or fail to carry out this agreement, said party of the second part may at any time annul the same, and contract anew with other parties, without prejudice to its claim for damages arising from breach hereof.

IN WITNESS WHEREOF, the said New England Dredging Company has caused its corporate seal to be hereto affixed, and these presents to be signed and delivered, in its name and behalf, by Charles H. Souther, its President and Treas-

urer, and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered, in its name and behalf, by its Board of Harbor and Land Commissioners, the day and year first above written, and the same to be approved by its Governor and Council.

NEW ENGLAND DREDGING COMPANY,

BY CHARLES H. SOUTHER, [SEAL OF NEW ENGLAND
DREDGING CO.]
President and Treasurer.

THE COMMONWEALTH OF MASSACHUSETTS,

BY JOHN E. SANFORD, } *Harbor and*
FRANCIS A. NYE, } *Land*
HENRY L. WHITING, } *Commissioners.* [SEAL OF THE
COMMONWEALTH.]

Executed in presence of

D. KOPPMANN,

Witness to all the signatures.

In Council, August 15, 1882. Approved.

HENRY B. PEIRCE, *Secretary.*

[4.]

[See page 4 of Report, *ante.*]CONTRACT OF THE COMMONWEALTH WITH STEPHEN
JENNEY & COMPANY.

This Indenture, made this first day of July, 1882, by and between the Commonwealth of Massachusetts, party of the first part, and Bernard Jenney and Francis H. Jenney, co-partners, doing business under the name of Stephen Jenney & Company, parties of the second part, witnesseth: —

Said party of the first part covenants and agrees that it will not, for the term of three years from the day of the date hereof, hinder or obstruct the access of said parties of the second part, their heirs and assigns, to their wharf, situate at South Boston, and known as Jenney's Wharf, by any filling or deposit made, or structure built, or other thing done by it, or under its license or authority, between said wharf and a line indicated by the red line A B C on the plan* hereto annexed and made a part hereof; nor, in any manner as aforesaid, during said term, cut off the approach to said wharf, from the main harbor of the City of Boston, by some channel or course having as deep water as the present channel or course affords.

Said party of the first part doth also hereby lease, demise and let unto said parties of the second part, to have and to hold to them, their heirs and assigns, for the term aforesaid, a certain rectangular parcel of land or flats, lying adjacent to their wharf aforesaid, and indicated on said annexed plan* by the letters D E F and G, placed in red ink at the several corners thereof; together with all the right, title and interest which said party of the first part hath in and to so much of the street laid out or projected, and called E Street, as lies between said parcel and Monks Wharf, and between the lines E F and D G, on said plan, extended.

* The plan referred to is on file in the offices of the Secretary and the Treasurer of the Commonwealth, and of this Board.

In consideration of the foregoing, said parties of the second part, for themselves, their heirs, executors, administrators and assigns, covenant and agree to pay to said party of the first part, the sum of six hundred and fifty dollars (\$650) each year during the term aforesaid, in equal semi-annual instalments of three hundred and twenty-five dollars (\$325) each, payable on the first days of January and July, the first payment to be made on the first day of January, 1883.

IN TESTIMONY WHEREOF, the said party of the first part, by its Board of Harbor and Land Commissioners, has caused these presents to be executed in its name and behalf, and its seal to be hereto affixed, and the same to be approved by its Governor and Council; and the said parties of the second part have hereunto set their hands and seals, the day and year first above written.

COMMONWEALTH OF MASSACHUSETTS,

By JOHN E. SANFORD,	} <i>Harbor and</i>	(SEAL OF THE COMMONWEALTH.)	
FRANCIS A. NYE,			<i>Land</i>
HENRY L. WHITING,			<i>Commissioners.</i>

BERNARD JENNEY. (SEAL.)

FRANCIS H. JENNEY. (SEAL.)

Signed, sealed and delivered in presence of

D. KOPPMANN, *Witness to all Parties.*

In Council, August 15, 1882. Approved.

HENRY B. PEIRCE, *Secretary.*

[5.]

[See page 4 of Report, *ante*.]CONTRACT OF THE COMMONWEALTH WITH THE
TRUSTEES UNDER THE WILL OF JOHN P. MONKS.

This Indenture, made this first day of July, 1882, by and between the Commonwealth of Massachusetts, party of the first part, and Richard J. Monks and Frank H. Monks, trustees under the will of John P. Monks, parties of the second part, witnesseth : —

Said party of the first part covenants and agrees that it will not, for the term of three years from the day of the date hereof, hinder or obstruct the access of said parties of the second part, their successors and assigns, to their wharf, situate at South Boston, and known as Monks Wharf, by any filling or deposit made, or structure built, or other thing done by it, or under its license or authority, between said wharf and a line indicated by the red line A B C on the plan* hereunto annexed and made a part hereof ; nor, in any manner as aforesaid, during said term, cut off the approach to said wharf, from the main harbor of the City of Boston, by some channel or course having as deep water as the present channel or course affords.

In consideration thereof, said parties of the second part, for themselves, their successors and assigns, covenant and agree to pay to said party of the first part, the sum of three hundred and fifty dollars (\$350) each year during the term aforesaid, in equal semi-annual instalments of one hundred and seventy-five dollars (\$175) each, payable on the first days of January and July, the first payment to be made on the first day of January, 1883.

IN WITNESS WHEREOF, the said party of the first part, by its Board of Harbor and Land Commissioners, has caused these presents to be executed in its name and behalf, and its seal

* The plan referred to is on file in the offices of the Secretary and the Treasurer of the Commonwealth, and of this Board.

to be hereto affixed, and the same to be approved by its Governor and Council; and the said parties of the second part have hereunto set their hands and seals, the day and year first above written.

COMMONWEALTH OF MASSACHUSETTS,

By JOHN E. SANFORD, } *Harbor and*
FRANCIS A. NYE, } *Land* (SEAL OF THE
HENRY L. WHITING, } *Commissioners.* COMMONWEALTH.)

RICHARD J. MONKS, } *Trustees.* (SEAL.)
FRANK H. MONKS, } (SEAL.)

Signed, sealed and delivered in presence of

D. KOPPMANN, *Witness to all Parties.*

In Council, August 15, 1882. Approved.

HENRY B. PEIRCE, *Secretary.*

[6.]

[See page 3 of Report, *ante*.]SUPPLEMENTARY CONTRACT OF THE COMMON-
WEALTH WITH THOMAS POTTER.

Supplementary Agreement, made this twenty-sixth day of December, 1882, by and between Thomas Potter, party of the first part, and the Commonwealth of Massachusetts, party of the second part.

Whereas, the said parties, on the 28th day of August, 1880, entered into an agreement in writing, which is referred to and made a part hereof as if fully recited herein, whereby the said Potter, upon the terms and conditions in said agreement set forth, agreed to do certain dredging in Boston Harbor and, with the material so dredged, to fill certain flats of said Commonwealth at South Boston ;

And whereas, it was stipulated in said agreement that the aforesaid dredging and filling should be completed by said Potter on or before the first day of January, 1883 ;

And whereas, the said Potter will be unable to complete said work on or before said first day of January, 1883, and desires an extension of time for completing the same :

Now, therefore, it is agreed by the parties hereto, that the time for executing and completing the work stipulated to be done by the said Potter in the agreement aforesaid, shall be, and is hereby, extended one year from and after said first day of January, 1883.

It is also agreed that said Commonwealth may, by its Board of Harbor and Land Commissioners, and in their discretion, appoint from time to time a suitable person as inspector, who shall have supervision, subject to the direction and control of the engineer of said Board, of the place and depth of the dredging to be done by said Potter under said original agreement ; and the compensation of such inspector, at a reasonable and ordinary rate for such service, shall be paid by said Potter, by deducting the same from the pay-

ments which may be due him from time to time under said agreement.

All the provisions of said original agreement of August 28th, 1880, regarding rate of compensation per cubic yard, and otherwise, shall be and remain in full binding force upon the parties hereto, except so far as expressly modified by the provisions of this agreement as aforesaid.

IN TESTIMONY WHEREOF, the said Thomas Potter has hereunto set his hand and seal, and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered, in its name and behalf, by its Board of Harbor and Land Commissioners, the day and year first above written, and the same to be approved by its Governor and Council.

THOMAS POTTER.

[SEAL.]

COMMONWEALTH OF MASSACHUSETTS,

By JOHN E. SANFORD, } *Harbor and*
FRANCIS A. NYE, } *Land*
HENRY L. WHITING, } *Commissioners.* [SEAL OF THE
COMMONWEALTH.]

COMMONWEALTH OF MASSACHUSETTS.

BOSTON, January 1, 1883.

Approved by the Governor and Council.

HENRY B. PEIRCE,
Secretary of the Commonwealth.

[7.]

[See page 40 of Report, *ante*.]

UNITED STATES ENGINEER OFFICE,

WAREHAM, MASS., December 18, 1882.

To the Hon. the Board of Harbor and Land Commissioners.

GENTLEMEN, — In reply to your request of the 14th inst., I have to state that it is only since September last that I have been charged with river and harbor improvements under the general government within the limits of your Commonwealth, and consequently there is little to be said upon the subject in addition to the data you have probably already before you.

At the above mentioned date, I took charge of the harbors of Hyannis and Wareham, vacated by the death of the late General Warren, and subsequently relieved General Thom of the charge of the harbors of Scituate, Plymouth and Provincetown. Although but little has been done within the limited period I have had charge of these works, I am happy to furnish you with the information I understand you to desire even as regards that little, and as follows.

Hyannis.

This is a completed harbor, the charge consisting in seeing that the stone breakwater protecting the anchorage is kept in repair.

General Warren, in his last annual report, suggests improvement of the channel of entrance by dredging. I shall examine into the matter and follow it up in my next annual report.

Wareham.

The improvement is designed to afford a commodious channel from Buzzard's Bay to the town front, through which vessels drawing thirteen feet can sail at high tide. This involves the expenditure of about \$30,000 in dredging, which can only be done advantageously in bulk, and con-

sequently the small appropriation of \$5,000, made at the last session of Congress, is now being expended upon catch-sand fencing on Long Beach, a sand spit which is encroaching on the navigable channel.

By aid of this \$5,000, within a month or so I shall have this sand spit thoroughly under my control, arresting all further channel encroachment, and raising the beach beyond flood-tide level, ready to be planted with beach grass in 1883, which measure will fully complete the desired improvement as far as this beach is concerned, all further operations being simply designed to widen the beach, and to place it in such condition as to be beyond danger of incommoding the channel hereafter.

The work of securing this beach is being done by building brush fences, of alternate layers of scrub-pine trees and stone, to a height of three feet. These catch the sand, but are soon enveloped with it, the practical result, however, being to raise the beach to the height of their crest, and to the width between the fences. General Warren's work has resulted in bringing up the beach to high-tide level. I am now building a frame barrier, 1,000 feet long, on the basis of his work, by which I expect to bring the crest of the beach at least two feet above flood-tide level, and, when it is planted with beach grass, the improvement will be permanently secured.

The prime necessity of this harbor now is an appropriation of at least \$10,000, to enable the channel improvement, by dredging, to be undertaken. A less amount than \$10,000 is inadequate even to begin the work.

Scituate, Plymouth and Provincetown.

For your fuller information with regard to the stage of improvement of these harbors, I have the pleasure to mail you herewith a marked copy of the annual report of General Thom, which carries the history of the several improvements as far as June, 1882. I have only to add, with regard to

Scituate,

That the contractor is now vigorously prosecuting his contract, in connecting the last year's work with the shore line above high tide, at the old Cedar Point lighthouse.

Plymouth.

The contractor has placed 1,888 tons of stone upon the shore protection at the inner end of Long Beach, and has nearly connected the enrockment with the main land at the point I have indicated to him. This improvement will permanently hold the end of the beach, but will not protect the adjacent channel to Plymouth wharves from encroachment by the sand carried from the beach into the channel through the enrockment by undertow. Consequently, in my next annual report, I shall estimate to secure this beach in a manner, not only to take care of the beach itself, but to prevent damage to the channel.

Provincetown.

Here the preservation of Long Point only is in question at present, although the whole peninsula, from Truro, both on the Atlantic and Massachusetts Bay side, needs watching. I shall patrol it personally before making my next annual report. At Long Point, the beach protection (enrockment) should have been continued this year to high-water line, and thence an apron of granite blocks should be carried at least a hundred feet along the beach. On assuming charge of these works, I tried to have this done at once, but I was unable to find contractors or men who would undertake it, to carry it out completely, so late in the year. As the incomplete work would damage the beach more than it would do it good, I have given the matter over until next spring, and will have it under contract by that time.

In conclusion, I beg leave to state that I am glad to have received your letter of the 14th inst., as I recognize the fact that the interests of the United States and the Commonwealth are identical in these matters, and can best be subserved by free communication between their several agents. Accordingly, I am always at the service of your honorable body, as far as our several duties concur, and have the honor to be,

Very respectfully,

F. HARWOOD,
Major of Engineers.

[8.]

[See page 26 of Report, *ante.*]

COMMONWEALTH OF MASSACHUSETTS.

In the year one thousand eight hundred and eighty-three.

AN ACT to define the Boundary Line of Tide Water between the State of Massachusetts and the State of Rhode Island and Providence Plantations.

Be it enacted, etc.:

SECTION 1. The boundary line of tide water between the State of Massachusetts and the State of Rhode Island and Providence Plantations, is hereby located and defined as follows: Beginning at the southerly end of the boundary line of land between the said States, as the same is now established by law, and thence running southerly, in a course across and at right angles with the shore line, (which is a line drawn from the headland at Gooseberry Neck, in the former State, to the headland at Warren's Point, in the latter State,) to a point in latitude $41^{\circ} 25' 05''$, longitude $71^{\circ} 05' 28''$, and distant one marine league, southerly, from the said shore line.

SECTION 2. This act shall take effect when the said boundary line, as herein located and defined, has been approved and established by the General Assembly of the State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

Mass
HARBOR AND LAND COMMISSIONERS

FOR

THE YEAR 1883.

BOSTON :

WRIGHT & POTTER PRINTING CO., STATE PRINTERS,

No. 18 Post Office Square.

1884.

C

APPENDIX.

Commonwealth of Massachusetts.

HARBOR AND LAND COMMISSIONERS' REPORT.

To the Honorable the Senate and the House of Representatives of the Commonwealth of Massachusetts.

The Board of Harbor and Land Commissioners, in accordance with the provisions of law, respectfully submit their Annual Report for the year 1883.

BACK BAY LANDS.

The Commonwealth has realized from the sale of its lands on the Back Bay, up to the present time, after deducting the cost of filling and improvement, and the expenses of auction sales, the net sum of \$3,285,602.68; and it may be safely estimated that a further sum of \$180,000 will be received for the lots remaining unsold.

It is interesting to notice that these large amounts will have accrued from the actual sale of less than one-half of the entire area originally owned by the Commonwealth. More than two-fifths of the whole area were devoted to avenues, streets and passage-ways; and nearly one-seventh of the residue reserved for sale, has been donated to the city of Boston and to public institutions.

The sales during the year 1883 have been as follows : —

19,040 feet on Boylston Street, north side, for . . .	\$76,048 00
12,320 feet on Newbury Street, north side, for . . .	48,160 00
9,408 feet on Newbury Street, south side, for . . .	31,808 00
2,744 feet on Marlborough Street, north side, for . . .	12,348 00
<hr/>	
43,512 feet in all, sold for	\$168,364 00

The prices of lots have been gradually advanced from time to time. The highest price per foot obtained in 1883, was \$4.50, the lowest price \$3.00, and the average price \$3.8693. Nearly one-half of all the land remaining for sale at the beginning of the year 1883 was disposed of during the year.

The land still unsold is located as follows : —

	FEET.
On Boylston Street, north side,	17,136
Boylston Street, south side,	7,875
Newbury Street, south side,	8,400
Commonwealth Avenue, south side,	3,237
Marlborough Street, north side,	8,008
	<hr/>
Total unsold,	44,656

A summary statement is here presented, showing the sales and other disposition of the Back Bay lands, the gross receipts and expenditures, and the net proceeds, on account of the same, from the beginning of the enterprise to the present time : —

In 1857, the Commonwealth owned on the Back Bay,	4,723,998	FEET.
Of which there have been donated,	363,308.00	FEET.
Devoted to streets and passage-ways,	2,037,068.60	
Sold, as per last Report,	2,235,453.40	
Sold in 1883,	43,512.00	
	<hr/>	
	2,278,965.40	
Remaining for sale December 31, 1883,	44,656.00	
	<hr/>	
	4,723,998	
	<hr/>	
The gross proceeds of land sold, as per last Report,	\$4,755,239 17	
The gross proceeds of land sold in 1883,	168,364 00	
	<hr/>	
	\$4,923,603 17	
Rights in Parker Street sold, as per last Report,	2,300 00	
	<hr/>	
	\$4,925,903 17	
Cost of filling, grading, etc., as per last Report,	\$1,626,008 71	
Cost of auction sales, as per last Report,	14,291 78	
	<hr/>	
	1,640,300 49	
	<hr/>	
Net proceeds to December 31, 1883,	\$3,285,602 68	

BUILDINGS ON THE BACK BAY.

The attention of the Board is called with increasing frequency to cases of the alleged erection or use of buildings, on the Back Bay, in a manner contrary to the stipulations of the deeds by which the premises have been granted by the Commonwealth; or its advice is sought in regard to the proper manner of the erection and use of such buildings.

With the growing tendency of owner and architect to engraft new features upon the plans and style of building, an increased strain is brought to bear on the limitations of the deed. Variety of architectural effect, so far as it is attainable within the limits of correct taste, and with a due regard for rights which the Commonwealth is bound in good faith to protect, and without impairing the force of regulations which it is for the interest of all to maintain, — ought not to be discouraged.

The restrictions which inhere in the title of the Back Bay lots, were wisely adapted to make them desirable to purchasers, and to enhance their value to both seller and buyer, by carefully guarding the manner of their occupation and use. The intention was, and the result has been, to make the Back Bay an especially attractive place for residence, and for such other uses and pursuits as shun the annoyance and unsightliness of the factory and workshop, and the encroachments of business and trade.

The plans of the Commonwealth were taken on a liberal scale. Large areas were devoted to public use and ornament. Spacious avenues were laid out, and their breadth and elegance were made still more effective by the reservation of ample marginal spaces for turf, shrubbery and other ornamentation, upon which no building should encroach except under strict and uniform limitations. All buildings were required to be of a height in keeping with the general scale; and no building was suffered to obstruct the light and outlook of other buildings more than its own were liable to be obstructed.

Owners of estates who have been induced to purchase by reason of these regulations, and who have kept within the stipulations of their deeds in the erection and use of build-

ings on their own lands, have just ground of complaint if others are allowed to disregard them; and the Commonwealth would be guilty of gross neglect if, by its proper agents, it made no effort to prevent or remedy the wrong.

There is already ample reason to apprehend the effect of infringements which, though not serious in themselves, involve the principle of the restrictions, and become mischievous precedents for larger and bolder encroachment. The distinctive character of the Back Bay, in the features here referred to, can be kept intact and permanent, only by resolutely maintaining the limitations upon its occupation and use which have made it what it is.

The consequences of a violation of restrictions which attach in perpetuity to the title derived from the Commonwealth, are so serious to the owner of the estate, — exposing him to the peril of intrusion and legal interference, and operating like a cloud on the title to impair the market value of his property, — that it may be presumed that such violations occur oftener from ignorance, or inadvertence, or bad advice, than from deliberate purpose.

For the convenience of the Board upon occasions when its advice or direction may be hereafter sought, and also, it is hoped, for the better information of all interested parties, an attempt is made, on the following pages, to reduce the stipulations of the deed to a system of rules, with notes and illustrations intended to make their meaning and intent clear. Some of the latter may seem too obvious to require statement, but the need of most of them has been suggested by cases within the experience of the Board.

It is desirable first to state, so far as applicable to the matter now in hand, the precise terms of the stipulations embodied in the deed, and also in the bond for a deed usually given at the time of the original purchase.

PROVISIONS OF THE BACK BAY DEEDS.

All deeds, and bonds for deeds, of Back Bay lands granted by the Commonwealth since January 28, 1863, have contained the following clauses, — others, not material to the present purpose, being here omitted : —

This conveyance is made upon the following stipulations and agreement :

1. That any building erected on the premises shall be at least three stories high for the main part thereof, and shall not, in any event, be used for a stable, or for any mechanical, [mercantile, *if the building is on Commonwealth Avenue,*] or manufacturing purposes.

2. That the front wall thereof, on [avenue or street], shall be set back [twenty, twenty-two, or twenty-five, *according to location,*] feet from said [avenue or street] ; *provided*, that steps, windows, porticoes, and other usual projections, appurtenant to said front wall, are to be allowed in this reserved space of [twenty, twenty-two, or twenty-five] feet, subject to the following limitations, namely :

First, that no projection of any kind (other than doorsteps and balustrades connected therewith, and also cornices at the roof of the building), will be allowed to extend more than five feet from said front wall into said space ; and

Second, that no projection in the nature of a bay-window, circular front, or octagon front, with the foundation wall sustaining the same (such foundation wall being a projection of the front wall), will be allowed, unless any horizontal section of such projection would fall within the external lines of a trapezoid whose base upon the rear line of the aforesaid space does not exceed seven tenths of the whole front of the building, nor exceed eighteen feet in any case, and whose side lines make an angle of forty-five degrees with the base ; and each house in a block shall be considered a separate building within the meaning of this limitation.

3. That no cellar or lower floor of any building shall be placed more than four feet below the level of the mill-dam, as fixed by the top surface of the hammered stone at the south-easterly corner of the emptying sluices.

4. That a passage-way, [sixteen or twenty-five, *according to location,*] feet wide, is to be laid out in the rear of the premises the same to be filled in by the Commonwealth, and to be kept open and maintained by the abutters in common.

And said Commonwealth reserves the right to enter upon the premises, by its agents and at the expense of the party at fault, to remove or alter, in conformity with the above stipulations, any building, or portion thereof, which may be erected on the premises by the said grantee, or his representatives or assigns, in a manner, or to a use, contrary to the above stipulations.

And the said Commonwealth doth covenant with the said [grantee], and his assigns, that the afore-granted premises are free from all incumbrances, except as mentioned in said stipulations above recited.

The corresponding clauses in the deeds and bonds given prior to January 28, 1863, — comparatively few in number, — were the same as the foregoing, with the exception of the *second* clause, which read simply as follows: —

2. That the front wall thereof, on [avenue or street], shall be set back [twenty, twenty-two, or twenty-five, according to location,] feet from said [avenue or street]; *provided*, that steps, windows, porticoes, and other usual projections appurtenant thereto, are to be allowed in said reserved space of [twenty, twenty-two, or twenty-five] feet.

It is stated in the Twelfth Annual Report of the Commissioners on Public Lands (1863), that the “more specific terms” of this clause, in the amended form first above given, were employed, after consultation with eminent architects, “to avoid the confusion in which the subject [of projecting fronts] was in danger of becoming involved hereafter, from the interpretation of the phrase *usual projections*, which each purchaser would refer to the date of his deed.” It also appears by the testimony of Franklin Haven, chairman of the Commissioners, as reported in the case of *Linzee v. Mixer*, 101 Mass. 523, that this amended form was not considered as changing the substantial meaning and intent, but as being a “fair construction of the restrictions and limitations of the former deed.”

RULES FOR THE ERECTION AND USE OF BUILDINGS ON
BACK BAY LANDS GRANTED BY THE COMMONWEALTH.

I. Height and Grade of Building.

1. The main part of the building must be at least three stories high.

There must be at least three stories above the grade of the street. A French or Mansard-roof story has been accepted as one of the stories required.

A church, or public hall, should be of a height in keeping with the scale here indicated, but the second and third floors may, of course, be omitted.

2. No cellar or lower floor of any building can be placed more than four feet below the level of the mill-dam, as fixed by the top surface of the hammered stone at the southeasterly corner of the emptying sluices.

The "hammered stone" is no longer accessible as a grade monument, but its level has been transferred to other monuments, and the proper grade for the building is furnished by the Inspector of Buildings or City Surveyor of the city of Boston.

The boundary lines of lots, and the line for the front wall of buildings, are located under direction of this Board, on application at this office.

II. Location of Building on Lot.

1. The front wall of the building, if located on either side of Commonwealth Avenue, must be set back *twenty* feet from said avenue; if located on the north side of Boylston Street, on the south side of Beacon Street, or on either side of Newbury Street or Marlborough Street, *twenty-two* feet; and, if located on the south side of Boylston Street, *twenty-five* feet, from said streets respectively.

The entire wall must be set back the distance specified, so that its face will be on the rear line of the reserved space.

Taking this clause literally, the front wall must be set back the prescribed distance, neither *more* nor less. Other clauses in the

deed, and the rules as here given, assume that it will be so placed. In the case of a detached building, — a public building, for example, occupying a square, or with open areas on each side, — there seems to be nothing in the *reason* of the restriction to prevent its being placed as far back as desired. It is hardly to be conceived that the owner of a building in a block, would place it further back than required by the deed. If, however, it is allowable to so place any building, and it is so placed, its projections, so far as they project beyond the rear line of the reserved space, must conform to the limitations of the deed in the same manner as if the front wall were on that line.

As regards buildings on corner lots, which have a secondary frontage on Arlington Street, or other parallel street crossing Commonwealth Avenue and the streets above named at right angles, there is no requirement in the deed of any reserved space between the building and such cross street.

2. A passage-way, in rear of the premises, *twenty-five* feet wide, if the lot is located on the south side of Boylston Street, and *sixteen* feet wide, if the lot has any other location above specified, must be kept open and maintained by the abutters in common.

No part of the building can project into or over this passage-way. The passage-way must be kept open its full width from the ground up to the sky. See *Schwoerer v. Boylston Market Association*, 99 Mass. 285.

III. *Projections of and from Front Wall of Building.*

Steps, windows, porticoes, and other usual projections, appurtenant to the front wall of the building, may be extended into the reserved space aforesaid, subject to the following limitations: —

- (1) Only usual projections are allowable.

In determining what is *usual*, reference must be had to usage in the city of Boston, established at the time of the original purchase from the Commonwealth, and not to usage which may be established at the time of the erection of the building.

Usual implies general use. A single, or a few, precedents or examples do not make a usage.

Projections must be usual in kind and in character. Details

of style and construction may be varied at pleasure; but projections which involve new methods or principles of construction, and require a larger occupation of the reserved space, are not allowable.

In particular, no usage or precedent which is contrary to, or in violation of, the express stipulations and limitations of the deed, can be adopted as a guide. "Usage may be admissible to explain what is doubtful; it is never admissible to contradict what is plain."

The case of *Linzee v. Mixer*, 101 Mass. 512, arose under the earlier form of deed which contains no specific limitations of projecting fronts. It was proved or admitted in this case, that an octagonal projection of the whole front wall of a dwelling house, except twenty-one inches at each end of the front, — such projection extending from the ground to the roof, and the extreme distance of projection being four feet eight and one-fourth inches, — was a *usual projection* in the city of Boston. But it was *held* to be in violation of the restrictions of the deed, as being substantially a projection of the whole front wall into the reserved space, contrary to the express stipulation that the front wall should be set back twenty-two feet.

(2) All projections must be appurtenant to the front wall of the building.

Allowable projections are of two classes: —

First, *Projections OF the front wall.*

Second, *Projections FROM the front wall.*

It will be important to observe this distinction hereafter.

Every projection must be a projection *of*, or a projection *from*, the front wall. In other words, the base of the trapezoid or rectangle, (within one of which figures, as will be hereafter seen, every horizontal section of every projection must fall,) must rest upon the front wall, and not wholly or in part upon another projection.

One projection cannot be appurtenant to another projection, — that is, cannot be a projection *of*, or a projection *from*, another projection. Porticoes and doorsteps, for example, must project from the front wall, and not from a bay-window, circular or octagon front.

(3) Doorsteps, and balustrades connected with doorsteps, and cornices at the roof of the building, may project from the front wall into the reserved space without limit of distance.

Such projections are subject to all other limitations applicable to projections of the *second* class.

(4) No projection of any kind, other than those last named, can extend more than *five feet* from the front wall into the reserved space.

No part or member of such projection can extend beyond the distance named. Every horizontal section of any projection, except those specified in limitation (3), must fall within a line parallel to, and five feet distant from, the face of the front wall.

(5) No projection in the nature of a bay-window, circular front, or octagon front, with the foundation wall sustaining the same (such foundation wall being a projection of the front wall), is allowed, unless any horizontal section of such projection would fall within the external lines of a *trapezoid* whose base upon the rear line of the aforesaid reserved space does not exceed seven-tenths of the whole front of the building, nor exceed eighteen feet in any case, and whose side lines make an angle of forty-five degrees with the base.

Each house in a block is to be considered a separate building within the meaning of this limitation.

The fourth side of the trapezoid must come within the preceding limitation (4).

This limitation (5), and the following limitation (6), apply to all projections of the *first* class.

The distinctive feature of a bay-window, circular or octagon front, is, that it is formed by a projection *of* the front wall; and all projections so formed, for the purpose or with the effect of enlarging the interior spaces of the building, or of enclosing spaces in advance of the line of its front wall, are projections *in the nature* of a bay-window, circular or octagon front, and are subject to all the limitations of such projections.

A *portico* is an outside space at the entrance of a building, covered with a roof supported by columns or posts, with front and

sides open to the light and air; and, as such, is subject to the limitations of projections of the *second* class. If, however, the front and sides are *enclosed* by a projection of the front wall, it ceases to be a portico, and becomes a projection in the nature of a bay-window, and subject to all the limitations of projections of the *first* class. If the outside door of a building were placed in such a projection, it would not admit of a portico. See limitation (2), page 11.

The owners of two adjoining houses cannot, by concert of plan, combine their fronts, and thereby enlarge the amount, or change the character, of the projection of either or both fronts: e. g., a house of 20 feet front admits of a limiting trapezoidal base of 14 feet; one of 30 feet front, 18 feet. Each base must rest upon its own front. The fronts cannot be treated as two fronts of 25 feet, admitting of two bases of $17\frac{1}{2}$ feet, nor can they in any respect, as regards projections, be treated as one front of 50 feet.

(6) Any number of projections of the front wall of a building, in the nature of a bay-window, circular front, or octagon front, are allowable, *provided*, (1) that the bases of all the limiting trapezoids within which their horizontal sections must severally fall, do not together exceed seven-tenths of the whole front of the building, and (2) that no one of the said bases exceeds eighteen feet.

The limitation in the deed was obviously drawn with special reference to dwelling houses on lots of an ordinary frontage, and practically admitting of only one such projection. How shall the limitation be applied to a longer front, say of 100 feet? Evidently according to the intent, — which is, that not over seven-tenths of the whole front shall be so projected, and that every such projection shall be limited by a trapezoid whose base does not exceed 18 feet. See Diagram No. 1, on page 15.

The limitation, as above stated, supposes the projections to be placed laterally to each other on the same level of the front, and not as under limitation (9), page 16.

Each house in a block is, of course, to be considered a separate building in applying this limitation.

(7) Any horizontal section of a projection not in the nature of a bay-window, circular front or octagon front, must fall within the external lines of a *rectangle* whose base is upon the rear line of the aforesaid reserved space.

This limitation applies to all projections of the *second* class.

The manifest purpose of all the limitations is, to require that the building, as defined by its front wall, shall actually, and in appearance and effect, stand back the prescribed distance from the street; and to keep its projections within such limits as not to form or have the effect of a continuous and advanced front.

It is to this end that the sides of the limiting trapezoid of the bay-window and other projections of its class, are required to *converge* at angles of 45° , thereby cutting off the corners of this important projection, and narrowing its front to less than half of its base. Triangular spaces are thus left between the sides of the trapezoid and the sides of a *rectangle* standing on the same base, as indicated by the letter C in the Diagrams on page 15. These *triangular spaces* are clearly intended to be left *open and unoccupied* by any projection whatever. If the side lines of the sections of other projections on either side of the bay-window may *diverge*, and encroach upon these spaces, the spaces may be filled up, and a continuous horizontal projection may thus be formed across the front of the building, and substantially the whole front, to a greater or less height, advanced into the reserved space. The main purpose of the limitations might thus be wholly evaded. Hence the general rule, that every projection must *keep within its own base*.

(8) If two projections are placed laterally to each other on the same level of the front, the base of the trapezoid or rectangle limiting the one must not overlap the base of the trapezoid or rectangle limiting the other.

This limitation, which applies to projections of both classes, rests upon the same reasons as the last, and is equally necessary to give effect to the limitations of the deed.

To apply the last two limitations to the common case of a bay-window and portico placed side by side on the same front, and referring to the Diagrams on page 15, — the base of the rectangle B which limits the portico, must not overlap the base of the trapezoid A which limits the bay-window; and no part or member of either portico or bay-window must encroach upon the triangle C which lies between the rectangle and the trapezoid.

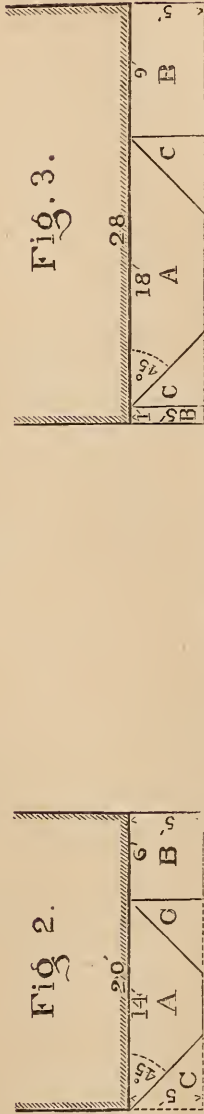
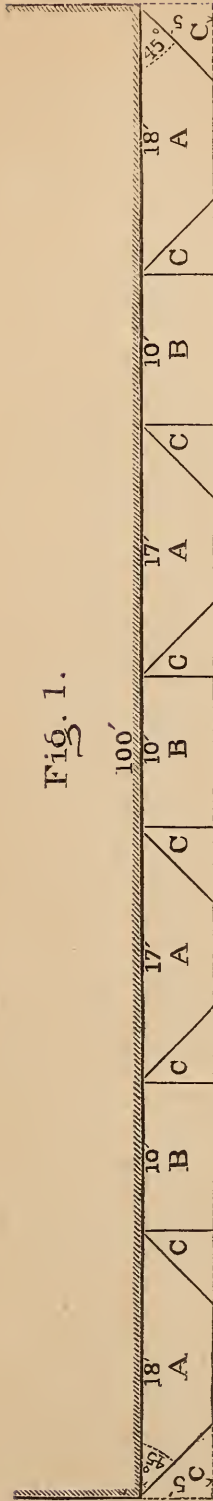
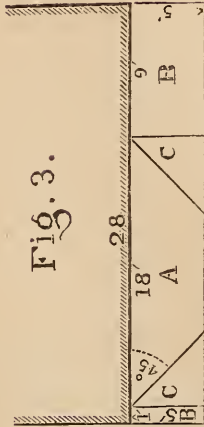


Fig. 3.



These Diagrams are intended to illustrate the limitations IN AMOUNT of the projections which may be placed laterally to each other on fronts respectively of 20, of 28, and of 100 feet; but without prescribing THE MANNER in which they must be arranged or grouped.

The TRAPEZOIDS A indicate the spaces which projections of the FIRST class, i. e., projections of the front wall, in the nature of bay-windows, etc., may occupy. See Limitations (5) and (6), pages 12 and 13.

The RECTANGLES B indicate the spaces which projections of the SECOND class, i. e., projections FROM the front wall, as porticoes, etc., may occupy. See Limitation (7), page 14.

The TRIANGLES C indicate the spaces which NO projection of either class must occupy. See Limitations (7) and (8), page 14, and notes appended thereto. In Diagram No. 1, front 100 feet, the bases of the trapezoids A cannot together exceed 7-10ths of the whole front = 70 feet; but the trapezoids may be of any number, and have any location desired, PROVIDED their aggregate bases do not exceed 70 feet, and no one base exceeds 18 feet. See Limitation (6), page 13.

In Diagram No. 2, front 20 feet, the base of the trapezoid A cannot exceed 14 feet = 7-10ths of 20 feet. See Limitation (5), page 12. In Diagram No. 3, front 28 feet, the trapezoid A is given the maximum of 18 feet, although, if more than one trapezoidal projection were practicable, the combined bases might be 19 and 6-10ths feet = 7-10ths of 28 feet. See Limitations (5) and (6), pages 12 and 13.

If, in any Diagram, the trapezoidal bases are SHORTENED, the bases of the rectangles may be LENGTHENED to the same extent, but NOT VICE VERSA. If a projection of the FIRST class, e. g., a bay-window, is placed ABOVE a projection of the SECOND class, e. g., a portico, the former must be limited by a trapezoid A; and the latter may be limited by a rectangle containing the same trapezoid A and the triangles C on each side of it. See Limitation (9), page 16.

It will, of course, be borne in mind that the trapezoidal and rectangular spaces above indicated, however graduated and arranged, can be occupied only by USUAL projections of their respective classes, conforming in all respects to the limitations given on the preceding pages.

(9) Projections without limit of number, class or kind, may be placed one *above* another, without intervening spaces, if each projection is in all other respects within the restrictions and limitations applicable to its class and kind.

There is nothing in the letter or spirit of the foregoing limitations in conflict with this limitation. A portico, for example, may support a bay-window, if the portico, as such, and the bay-window, as such, are each otherwise allowable.

It is not necessary that the projections be placed *vertically* one above another. It is sufficient if they occupy wholly different levels of the front.

Before leaving the subject of Projections, it may be remarked, that the foregoing limitations, as well as the notes and illustrations, have special application to what may be called *optional* and *movable* projections, which may be added to the front wall or not, as the owner pleases, and, if added, may, within certain limits, be located and grouped at pleasure. They do not apply in all cases with the same force to what may be called *necessary* projections, forming an essential part of the building, and having a fixed place and function in its structure. The cornice at the roof of the building, and the water-table at the base of the wall, for example, are in their nature *continuous* projections extending across the whole front of the building, and nothing on the foregoing pages is to be understood as interfering in such cases with the usual and necessary modes of construction.

IV. *Prohibited Uses of Building.*

The building must not, in any event, be used for a stable, for any mechanical or manufacturing purposes, nor (if located on Commonwealth Avenue) for any mercantile purposes.

No part of the building can be so used.

On the 27th of November, 1858, the Commissioners on the Back Bay passed the following vote, which is copied from their records:—“ *Voted*, That it is understood that the Commonwealth will not enforce the stipulation and agreement of the deed, that buildings erected on the Back Bay *shall not, in any event, be used*

for a stable, in such manner as to prevent the erection and use of private stables by gentlemen as appurtenances to their own dwelling houses; *provided*, such stables are so constructed and used as not to be justly offensive to the occupants of the surrounding buildings.”

All of the printed Catalogues, prepared and used in connection with the several auction sales of Back Bay lots, have contained a copy of the deed proposed to be given to purchasers, in the usual form, with a note appended, and a reference to the note at the word *stable*, as follows:—“It is understood that the Commonwealth will not enforce the stipulation and agreement of the deed, that buildings erected upon the Back Bay *shall not, in any event, be used for a stable*, in such a manner as to prevent the erection and use of private stables by purchasers as appurtenances to their residences; *provided*, such stables are so constructed and used as not to be justly offensive to the occupants of the surrounding buildings.”

With a few exceptions, the foregoing vote and catalogue note have not been embodied in the deeds given to purchasers, whether at public or private sale, either in terms, in substance, or by any reference thereto. How far the absolute prohibition of use for a stable, in a deed given in the usual form, may be qualified, in point of law, by these extraneous memoranda, *query*. Their purport as a collateral agreement is, that the Commonwealth, the grantor, will forbear to enforce the restriction regarding stables according to the strict letter of the deed. The deed itself gives no notice of such agreement to forbear. Assuming that the Commonwealth is bound, it may be a question how far the right of grantees under such deeds to enforce the restriction as against each other, as hereafter explained, is thereby abridged,—so far, at least, as purchasers at private sale, without express or actual notice of the collateral agreement, are concerned.

If the right to a stable exists in any case, such stable

- (1) Must be strictly a private stable.
- (2) Must be used by the owner or occupant of a dwelling house on the same premises as an appurtenance to such dwelling house.
- (3) Must be so erected and used as not to be justly offensive to the occupants of the surrounding buildings.

The other prohibited uses would, at the least, include the use of any building, or part thereof, as a factory or shop for the manufacture of articles intended for the market, or for the exercise of any mechanical trade or occupation with a view to profit and

general patronage; and, if the building is on Commonwealth Avenue, as a store or shop for traffic in merchandise or the sale of goods and articles to the general public.

V. *Remedies for Violation of Stipulations of Deed.*

(1) There is expressly reserved to the Commonwealth, in the deed, the right to enter upon the premises, by its agents and at the expense of the party at fault, to remove or alter, in conformity with the stipulations of the deed, any building, or portion thereof, erected on the premises by the grantee, or his representatives or assigns, in a manner, or to a use, contrary to said stipulations.

(2) Chapter 264 of the Acts of the year 1866 contained the following provisions, which are now incorporated in the

Public Statutes, Chapter 19, Section 5.

In all cases where the Commonwealth has the right, by its agents and at the expense of the party at fault, to enter upon premises and remove or alter a building, or a portion thereof, by virtue of the agreements or stipulations in a deed or deeds given in its name, all grantees under such deeds, and their legal representatives and assigns, shall have the right by proceeding in equity to compel the said Board [of Harbor and Land Commissioners] so to enter and remove or alter such building or portion thereof. The supreme judicial court shall have full jurisdiction of such proceedings, and shall have full power to make such orders and decrees as justice and equity may require to make the rights hereby granted effectual, and the attorney-general shall in all such proceedings appear for said Board and attend to the interests of the Commonwealth.

It was decided in the case of *Linzee v. Mixer*, 101 Mass. 512, which was a bill in equity filed under this statute to compel the alteration of a building, the Commissioners on Public Lands being joined as defendants, — that *all* of the grantees under such deeds need not be joined as parties in such proceeding, but that *each* grantee may so proceed at his own option.

The right of resort to a court of equity to enforce a compliance with the stipulations of the deed, was not, however, conferred by, and does not rest upon, the above statute, — the main purpose of which seems to have been to supply an

additional remedy, by providing a method of compelling the agents of the Commonwealth to exercise the right to enter, and to remove or alter a building, which is reserved in the deed.

Before the passage of the above Act of 1866, it was well established that deeds of parcels of the same tract of land, given by the same grantor, and containing like restrictions upon the manner of use and of building thereon, create an equitable easement in the estate of each grantee in favor of the grantor and of all other like grantees, which a court of equity will recognize and protect by enforcing compliance with the stipulations of the deed. Relief is thus granted by the court not only to the grantee of an adjoining lot, or of a lot abutting on the same street or passage-way, but to the grantee of any lot in the entire tract so parcelled out; and not only to the grantor and his immediate grantees, but to all who hold by mesne conveyance or otherwise under immediate grantees.

An important condition, however, attaches to the use of this remedy by one grantee or his assigns as against another. If the former would avail himself of his right to compel a compliance with the stipulations of the deed by resort to a court of equity, he must seasonably and with due diligence, after notice or knowledge of the alleged improper structure, advise the other party of his objections thereto, either directly, or through the intervention of the agents of the Commonwealth, or otherwise. He cannot, by silence and inaction, and with apparent acquiescence, allow the structure to be advanced to completion, without endangering or wholly losing his right to relief in a court of equity. "It would be contrary to equity and good conscience to suffer a party to lie by and see acts done involving risk and expense by others, and then permit him to enforce his rights and thereby inflict loss and damage on parties acting in good faith. In such cases, a prompt assertion of right is essential to a just claim for relief in equity." *Bigelow, J., in Whitney v. Union Railway Co.*, 11 Gray, 367. See also *Linzee v. Mixer*, 101 Mass. 526-8, in which the general principle just stated, as regards negligence or *laches*, is applied by the court, *Ames, J.*, to the facts in that case.

(3) In the case of the *Attorney General v. Gardiner*, 117 Mass. 492, it appeared that a certain structure, on a lot on Commonwealth Avenue, was in violation of the restrictions in an indenture between the Commonwealth and the Boston Water Power Company, providing for the concerted laying out of said avenue over their adjacent Back Bay lands, and regulating the manner of building thereon, — and also in violation of the restrictions in the deed by which the lot in question had been conveyed by the Commonwealth. The particular restriction violated was that requiring all buildings on Commonwealth Avenue to be set back twenty feet, with an allowance of usual projections. The unauthorized structure was built in this reserved space of twenty feet. It was *held* in this case, that the Commonwealth might enforce this restriction by an Information in Equity, filed in its behalf by the Attorney General, against any person bound thereby; and, upon such an information, the structure was ordered to be removed.

The court, *Gray*, C. J., in the opinion in this case, says: — “No question of *laches* appears to have been made at the hearing, or is reserved in the report, or, upon the facts found, could avail the defendant.”

The following opinion of the late Attorney General Marston, given in reply to inquiries which are necessary to its full meaning, is here presented as covering points of interest in this connection.

(COPY.)

HARBOR AND LAND COMMISSIONERS' OFFICE,
BOSTON, November 20, 1882.

Hon. GEORGE MARSTON, *Attorney General*:

DEAR SIR: The Commonwealth has conveyed a large portion of its Back Bay lands by deeds in the form hereto annexed [containing the same clauses as those already given on pages 7 and 8].

You will observe that the deed provides that a passage-way, sixteen feet wide, in the rear of the premises conveyed, is to be “*kept open*” by the abutters in common, and that a right is reserved to the Commonwealth to enter “*by its agents*,” and remove any structure erected contrary to the stipulations of the deed.

A bay-window, it is alleged, has been erected by a grantee under such deed, in or over such passage-way, in violation of the terms

of the deed. The Commonwealth still holds lands abutting on the same passage-way, the value of which is, or may be, affected by the unlawful structure. Complaint is also made to this Board by other grantees or purchasers of lands on the passage-way in question, of injury to their estates from the same cause. So far as is known, the bay-window complained of, and the building of which it forms a part, were fully completed before the present members of the Board, or their predecessors, or any persons having official charge of the Back Bay lands, had any notice or knowledge of their intended or actual erection.

The following questions are respectfully submitted for your opinion and advice: —

1. Are the Harbor and Land Commissioners "*agents*" of the Commonwealth within the meaning of the deed, so that the right reserved to enter and remove such unlawful structure may be exercised by them?

2. If the Commissioners are such agents, have they a right under the deed, or have they a right as Commissioners under chapter 19 of the Public Statutes, or under any law, to enter and remove such unlawful structure upon their own judgment and sense of official duty, without any preliminary proceedings in law or in equity to determine the lawfulness of such structure and the rights of all parties in relation thereto?

3. If they do so enter upon their own motion, and remove a structure in their judgment unlawful, do they incur personal liability if such structure is adjudged not to be unlawful?

4. Can the Commissioners institute, or cause to be instituted, any proceedings, in law or in equity, by which the right of the Commonwealth to remove, or the right of the respondent to maintain, the structure in question, can be first judicially determined, and a judgment, order or decree of the court obtained accordingly? Has the Commonwealth any remedy in such case by resort to the courts, and, if so, what is the remedy?

5. Can negligence or *laches* be set up as an objection or defence to any proceedings on the part of the Commonwealth, or the Commissioners, to remove such structure?

6. Can a grantee whose deed is subsequent to the erection of the structure complained of, be deprived of the remedy provided in chapter 19, section 5, of the Public Statutes, on the ground of negligence, delay or *laches*?

I am, very respectfully, yours,

For the Harbor and Land Commissioners,

JOHN E. SANFORD, *Chairman.*

(COPY.)

ATTORNEY-GENERAL'S OFFICE, BOSTON, November 21, 1882.

Hon. JOHN E. SANFORD, Chairman, etc. :

DEAR SIR: To yours of the 20th instant, I have the honor to reply as follows:—

1. I am of opinion that the Harbor and Land Commissioners are the agents of the Commonwealth in the matter referred to. The authority given in Public Statutes, chapter 19, section 3, to “prevent further encroachments and trespasses,” is sufficient to authorize action to prevent the further continuance of existing encroachments and trespasses.

2. In my opinion, the Commissioners have the right and power by law to enter and remove an unlawful structure such as is referred to in this inquiry.

3. In my opinion, the Commissioners would incur personal liability if it should appear that the structure which they assumed to remove was not unlawful.

4. But it is much better to resort to the courts; and, in my opinion, the Supreme Judicial Court has jurisdiction in equity adequate to reach the remedy, as for a nuisance, and probably otherwise. I should prefer to include as complainant some person interested alike with the Commonwealth.

5. I do not think *laches* or neglect can be set up against the Commonwealth or the present Commissioners.

6. Nor do I think a subsequent purchaser can be affected by *laches*; though this may admit of some question.

Very respectfully, etc.,

GEO. MARSTON, *Attorney-General.*

SOUTH BOSTON FLATS.

Progress of the Work.

The scheme for the improvement of the South Boston Flats, as originally conceived, and as in process of execution, contemplates the reclamation of an area of flats and shoal water extending from the northerly shore of South Boston to the main channel of Boston Harbor, with a deep-water frontage of $2\frac{1}{5}$ miles reaching from Fort Point Channel to Castle Island. The whole extent of this area, excluding the portion previously given to the Boston Wharf Company, is 710 acres.

It was obvious that the filling of so large a territory would require a considerable period of time, and that it would not be wise to take the whole tract in hand at once. The work naturally began at the Fort Point Channel end, nearest the city proper, and has extended thence, section by section, eastward towards Castle Island.

There has already been walled in, filled and sold, or sold to be filled and improved by the purchaser, a tract of $82\frac{6.8}{100}$ acres lying nearest Fort Point Channel. The total price obtained was \$1,539,519.20, of which \$552,987.20 has been actually received in cash. Of the unpaid balance, \$86,532 will be due July 1, 1890; \$800,000 will be due May 1, 1891; and \$100,000 will be due May 1, 1892, — making an unpaid total of \$986,532, on all of which interest is payable semi-annually, on the first two sums at the rate of four per centum, and on the last at the rate of five per centum, per annum.

Of the $82\frac{6.8}{100}$ acres so disposed of, all (except $\frac{8}{100}$ of an acre) has been sold either directly to the New York and New England Railroad Company, or has passed by transfer into its hands, and is now in the occupation of that company, which has expended large sums of money in filling, in the erection of buildings and docks, and in other improvements thereon. As security for the unpaid purchase money, the Commonwealth still retains the fee of the entire premises, and cannot be called upon to give a deed of any parcel thereof until all payments of principal and interest have been made, and all filling and other work done, and all

other conditions performed, as required by the legislative acts, or by the indentures and agreements, relating to such parcel.

It is proper to add that one of these parcels, the "12-acre lot," so called, was required by chapter 260 of the Acts of 1880 to be filled to the grade of 13 feet above mean low water before April 25, 1883. The railroad company has done no work on this lot since September, 1882, and 38,085 cubic yards of filling are yet to be done. Hardly any work has been done on the "50-acre lot" since December, 1882, although the work is agreed to be performed with all practicable despatch, and over 60,000 cubic yards of filling, besides pier work, remain to be done. On these two lots together, there are 3,717 cubic yards of filling yet to be levelled off. It is important for the Commonwealth that this agreed work should be completed, because the successful development of its own property lying beyond will be hindered if the improvement of these intervening parcels is too long delayed.

Turning now to the work of the Commonwealth in the further reclamation and improvement of these flats, — four additional sections, adjacent to those sold as above, are now in process of filling:

1. A section of $16\frac{53}{100}$ acres under a contract with Thomas Potter, dated August 28, 1880. The time for the completion of this contract, which has been twice extended, will expire June 1, 1884, and the agreed work is expected to be finished by that date. During the year 1883, there have been deposited under this contract 188,957 cubic yards of dredged material, equivalent, when levelled, to $10\frac{27}{100}$ acres of completed work,—by which is meant so much area filled with material dredged from the harbor to the grade of 13 feet above mean low water. This grade is to be hereafter raised by gravel filling, when and where found necessary, to a street grade of 16 feet above mean low water.

2. A section of $44\frac{38}{100}$ acres, under contract No. 1 with the New England Dredging Company, dated August 12, 1881. This contract bids fair to be completed by the time agreed, August 18, 1885. During the last year, 254,138 cubic yards of dredged material have been deposited under

this contract, equivalent, when levelled, to $13\frac{4}{10}$ acres of completed work.

Under both of the above contracts, an important secondary object is accomplished. The contractors are required to obtain the material for filling by dredging shoal places in the harbor proper to the depth of 23 feet at mean low water. About 72 acres have thus been already added to the deep-water area of the harbor in connection with the work at South Boston, all of which will be made fully available, probably before the close of present year, by the completion of the removal of the shoal in the main channel near the mouth of Fort Point Channel.

3. A section of $30\frac{29}{100}$ acres, under contract No. 2 with the New England Dredging Company, dated July 1, 1882. During 1883, there have been deposited, under this contract, 108,725 cubic yards of dredged material, equivalent, when levelled, to $7\frac{9}{10}$ acres of completed work.

This contract differs from the preceding in that the contractor is not required to dredge the material deposited by him, but to receive all proper material brought to him by other parties for which a dumping-ground is sought, and which, if not so utilized, would be wasted, or might work injury to the harbor by being dumped in improper places. The amount deposited under this contract represents approximately the amount of miscellaneous dredging done in Boston upper harbor during the year by the United States and other parties, except that done for the Commonwealth as above specified, and that done by the Mystic River Corporation.

Under all of the above contracts, the dredged material is first dumped from scows at receiving or elevating stations, is again hoisted by dredging machines into cars, and conveyed by locomotives over tramways to the place of final deposit, where it is levelled to the required grade.

4. A section of $8\frac{26}{100}$ acres nearest to the original shore line, and in rear of the above sections, has been reserved out of the above contracts, and is in process of filling at a small cost by the deposit from carts of ashes and other proper refuse material for which a dumping-place is sought by the city of Boston and other parties. About 40,000 cubic yards of such material have been deposited during

1883, making an area of about $2\frac{1}{2}$ acres of completed work.

In all, $99\frac{46}{100}$ acres are now under treatment as aforesaid, on which 591,820 cubic yards of material, equivalent to $33\frac{26}{100}$ acres of work completed to grade 13, have been deposited during 1883, — an amount greater by 190,000 cubic yards and 13 acres than in any previous year.

The whole amount of work done in 1883 and previous years on the area of $99\frac{46}{100}$ acres now under treatment, is equivalent to $55\frac{83}{100}$ acres completed to grade 13.

There have also been built during the last year 176 linear feet of bulkhead to hold and protect filling, and about 1,000 feet have been repaired and strengthened.

A Plan of a part of Boston Harbor appended to this Report, though specially prepared for another purpose, will exhibit to the eye the tract already sold, the sections now in process of filling as above specified, and the area yet to be taken in hand, in connection with this great enterprise.

Acquisition of Riparian Rights.

With a view to obtaining full control for purposes of reclamation, provision was made by chapter 446 of the Acts of 1866, and by subsequent acts and resolves, for the purchase, in the name and behalf of the Commonwealth, of the rights of all other parties in and to the flats along the South Boston shore as far east as the easterly line of E Street extended, which coincides nearly with the westerly line of Monks Wharf.

A strip of flats along the upland, already partially improved by the riparian owners, 220 feet in width, lying between First Street and a projected parallel street called Cipher Street, was left out of the purchase for the owners to fill and further improve on their own account. All known claims to title in all the rest of the flats between B Street on the west and E Street on the east, have been extinguished by purchase and conveyance to the Commonwealth, except an undivided $\frac{1}{7}$ th interest in the "Cains Lot" adjoining B Street, and an undivided $\frac{3}{80}$ ths interest in the "Fan Piece" near D Street.

Repeated efforts have been made to buy these outstanding

rights, and appropriations for that purpose have been made and renewed from time to time, the last of which has now lapsed. Recent negotiations have left the impression that the parties are not anxious to sell at any reasonable price, and prefer to bide their time. Meanwhile the work of filling goes on. The Commonwealth is exempt from suits, and suffers no present inconvenience; but, when ready to sell, will be unable to give a perfect title, and may be seriously embarrassed in finding a purchaser or getting its price.

Viewing the work at South Boston as a great public harbor improvement, — which was and is its primary object, — the legislature has wisely determined that the acquisition and control of these flats is a necessary step in its execution; and it seems proper that the right to take property should now be invoked in its aid. With a view to acquiring these known interests, which it is impracticable to buy, and other possible interests not yet brought to light, and thus perfecting the title of the Commonwealth, it is recommended that authority be given to take all the flats within the limits above described, with full provision for compensation, and an appropriation sufficient to cover the probable outlay.

Provision for Continuing the Work.

The net proceeds of the sales of the reclaimed flats on the Back Bay, and of other tide-water lands sold by the Commonwealth, — amounting to \$3,500,000 in round numbers, — would supply the natural fund on which to draw for the first cost of a work of like character. The moneys so received have, however, and probably not unwisely, all been covered into funds and sinking-funds established for various purposes, or have been otherwise applied, and are not available for the work now in hand.

The outlay in all such enterprises necessarily goes before the return. Land cannot be sold until it is fit for the market. So far as the account with the South Boston enterprise can be closed, the balance is in favor of the Commonwealth. The cost of improvement of the $82\frac{6.8}{100}$ acres already sold was \$869,765.93. The price obtained, as before stated, was \$1,539,519.20, — showing a net gain to

Commonwealth of \$669,753.27; and this, notwithstanding the tract sold includes the "25-acre lot," lying at the junction of Fort Point Channel with the main harbor, requiring a costly sea-wall on two sides of it, with no land to sell in rear of it, and costing for its improvement several times the sum required for any other area of equal extent.

The total cost of the enterprise to December 31, 1883, for improvement of land sold and unsold, and including \$243,091.41 paid for the flats purchased from riparian owners as above mentioned, is \$1,540,581.66. The whole amount received from sales and rents to the same date is \$1,550,019.20, — showing still a balance in favor of the enterprise, excluding interest from both sides of the account, of \$9,437.54. To this balance is to be added the increased value of $99\frac{46}{100}$ acres of flats in process of filling, equivalent to $55\frac{83}{100}$ acres already filled to grade 13, and on which there has been actually expended, including cost of flats purchased as above, \$670,815.73.

It is not deemed necessary at this late day to urge the general advantages to the Commonwealth, and to the trade and business of its chief commercial city, which will accrue from the carrying out of this great enterprise, or to repeat the arguments which, apart from the consideration of the pecuniary results to be expected, have induced the legislature to sanction and undertake the work. The evident advantages were certainly never greater, and the arguments never had more force than now.

To provide for the cost of the work, in anticipation of receipts from future sales, the "Commonwealth's Flats Improvement Fund" was established by chapter 237 of the Acts of 1878, and the sum of \$200,000 appropriated from the fund to meet all payments authorized and required to be made under the laws providing for the improvement and sale of the South Boston flats. A further appropriation of \$500,000 was made from this fund for the same purposes by chapter 71 of the Resolves of 1881.

The unexpended balance of these appropriations, January 1, 1884, is \$223,947.19, and the amount of money actually in the fund and available for carrying on the work, is \$212,031.96. The whole of this sum, and something more, will

be required to pay for the work already under contracted in process of execution. Two of these contracts expire as present year. To enable the making of contracts for the continuance of the work, an additional appropriation will be necessary, which should be large enough to allow the making of contracts on a scale consistent with the highest economy, both as regards terms and the best development of the general plan of improvement.

RECEIPTS FROM GRANTS OF TIDE-WATER LANDS.

The amount received during the past year for grants of rights and privileges in tide-water lands of the Commonwealth, under licenses of this Board for filling and for the erection of wharves and other structures in and over tide-waters, is \$7,031.25. Payment for such grants was first required by chapter 284 of the Acts of 1874, now chapter 19, section 16, of the Public Statutes. Since the passage of that act, the total amount so received and paid into the State treasury has been \$152,209.27. Before its passage, large tracts of valuable territory were given for the asking, to the great advantage of the recipient, and sometimes to the injury of the public and the hindrance of other and better schemes of harbor improvement.

REMOVAL OF WRECKS.

Under the provisions of chapter 260 of the Acts of 1883, entitled "An Act to provide for the Removal of Wrecks and other obstructions from Tide-Waters," the Board received notice the last autumn from Mr. Charles F. Dunham, a commissioner of wrecks and shipwrecked goods for Dukes County, of the existence of several wrecks in the waters of Edgartown harbor. Upon a visit to the locality in question by a member and the engineer of the Board, it was found that there were four such wrecks in all, only two of which were in positions likely to interfere with the navigable and anchorage room of the harbor. These two were vessels which had taken fire from the combustion of their cargoes of lime, in consequence of leakage caused by damage in gales of wind, in which condition they were run aground and scuttled in order to subdue the fires, and afterwards aban-

ed. This occurred in 1869, and the sunken vessels have since remained quite near together on the northerly edge of the channel, and in sufficiently deep water, (one being in about 11 feet, and the other in about 14 feet, at mean low tide,) to cause serious obstruction and even danger to other vessels passing or anchoring near them. Their removal, therefore, was deemed necessary to the safety and preservation of the harbor.

Proposals for the execution of this work were duly advertised, and the lowest of the bids received was that of Capt. George W. Mudget, of Edgartown, who proposed to break up and remove both of the wrecks referred to, including their cargoes, to some place above high-water mark, or other place approved by the Board, for the sum of \$1,475. This offer has been accepted, and the work will be undertaken the coming spring. In the meantime notice has been given to the supposed owners of these wrecked vessels in accordance with the provisions of the act referred to.

It may here be remarked that the above act will undoubtedly prove a wise and useful one, not only by its provisions for the removal of existing obstructions, but by preventing the abandonment of vessels and the placing of unlawful obstructions in tide-water where their removal may be required at the cost of the party at fault. Cases have already occurred where its usefulness in the latter direction has been proved.

CHARLES RIVER BASIN.

By chapter 211 of the Acts of 1881, the Charles River Embankment Company was authorized to fill and improve certain lands and flats in the City of Cambridge, and was required within three years from April 21, 1881, to deposit thereon not less than 300,000 cubic yards of earth dredged from Charles River Basin, between West Boston and Brookline bridges, in such localities and to such depths as this Board should prescribe. Directions have accordingly been given and reports made to the Board of the progress of the work.

The whole amount of filling with material so dredged, to December 31, 1883, is 142,683 cubic yards. One thousand feet of sea-wall have been built. Owing to ice and cold

weather, all of the cap-stones of this wall have not yet been put in place, but this work is expected to be done as soon as the spring opens.

LOCAL HARBOR FUNDS.

It is expected that works of general harbor improvement and preservation will be done by the national government. There is, however, in every considerable harbor, frequent demand for improvements of a more special and limited character for which other provision must be made.

By chapter 149 of the Acts of 1866, compensation in money or kind for tide-water displaced, was first authorized to be assessed upon all parties who should thereafter fill flats or erect structures in tide-water. If levied in money, the money was to be paid into the treasury of the Commonwealth, and to constitute a special fund for the improvement of the harbor from which it was collected. The Act of 1866, as amended in some details by later statutes, is now incorporated in the Public Statutes, chapter 19, section 14.

This system of assessment has from the first been applied in Boston Harbor, and with very happy results. By means of the compensation fund so created, the Board has been enabled to make, or to aid in making much needed improvements which the national government could not be expected to make, and which otherwise would have been impracticable; and the usefulness of the fund will be greater and more apparent from year to year.

It is to be regretted that the system has not been applied from the outset to all the more important harbors of the Commonwealth. Though not too late to begin, the need of a fund already established is felt. In Gloucester Harbor, for example, which has become second in importance only to Boston Harbor, there is frequent pressure to relocate the harbor lines so as to permit the further encroachment of wharves upon its reserved areas, and the capacity of the harbor is likely in time to be fully tested. As its room is diminished, its quality needs to be improved. It is worthy of present consideration whether an improvement fund for this harbor might not now be wisely created, not only by

applying the system of compensation to future structures, but by an equitable assessment, either voluntary or under special provision of law, upon existing structures. The same suggestion would not be out of place in regard to other principal harbors.

BOUNDARY LINES BETWEEN CITIES AND TOWNS BORDERING UPON THE SEA.

The Board has made progress, during the past year, in the work devolved upon it by chapter 196 of the Acts of 1881, of locating and defining the boundary lines between cities and towns bordering upon the sea, from high-water mark outward to the line of the Commonwealth.

To do this work properly requires a careful search for ancient colony ordinances and records and for legislative acts bearing on the town lines, for records of perambulations by selectmen, and for all other information that can be got by appointed meetings with the town officers and from other sources. A study of charts and of coast and channel lines must then be made, and plans prepared on which the proper tide-water bounds may be worked out and finally delineated. In work of this nature and importance, safe progress is more to be desired than hurried dispatch.

The Act of 1881, which authorizes and directs the Harbor and Land Commissioners to locate and define the boundary lines in question, requires them to "file a report of their doings, with suitable plans and exhibits showing the boundary lines of any town by them located and defined, in the registry of deeds in which deeds of real estate situated in such town are required to be recorded, and also in the office of the Secretary of the Commonwealth." The filing of such report, plans and exhibits is understood to be the final and conclusive act of the Board establishing such boundary lines.

The tide-water boundaries of the several sea-bordered cities and towns in the counties of Bristol, Dukes County, Nantucket, and Barnstable, have been so established during the past year, by filing in the proper registry of deeds an explanatory and descriptive report in print, with elaborate plans, defining in words and exhibiting to the eye the boun-

daries of the cities and towns within such registry district, and by also filing in the office of the Secretary of the Commonwealth a duplicate of each report and set of plans. Extra copies of the printed report, without the plan, have also been sent to each registry and to each of the cities and towns concerned.

It is believed that these reports and plans will not only give full and correct data to such as may have occasion to consult them, but will, when the other counties are completed, furnish a ready and convenient basis for exhibiting accurately on the next published map of the Commonwealth the limits of its jurisdiction over the sea as well as the land, and the tide-water bounds of its several counties and municipalities.

During the year the preliminary work of locating and defining these boundaries along the coasts of Plymouth, Norfolk and Suffolk Counties, and a part of Essex County, has also been carried forward; and similar reports and plans will be prepared and filed for each of these counties in due time. The recent change in the location of the rooms of the Board has interrupted and delayed this and other office work, particularly that involving the use and preparation of maps and plans.

FISH-WEIRS.

It is provided in section 70 of chapter 91 of the Public Statutes, that “The mayor and aldermen of a city, and the selectmen of a town, lying upon tide-water, may authorize in writing any person to construct fish-weirs in said waters, within the limits of such city or town, for a term not exceeding five years: *provided*, such weirs cause no obstruction to navigation, and do not encroach on the rights of other persons.”

Without going into the facts and grounds of complaint in detail, there is reason to believe that this statute, seemingly so well guarded in its provisions, is not working to the satisfaction of either fishermen or sailors, nor, it is said, of the people of the towns. The fishermen complain that it does not protect their weirs as against vessels, and the sailors that it does not protect their vessels as against fish-weirs. Both are right. Practically, the statute does not give any certain

and definite protection to fish-weirs as duly authorized and lawful structures, nor does it prevent the erection of fish-weirs which are a serious obstruction to navigation.

Navigation and fisheries are both important interests, and neither is to be ignored in dealing with this question. They meet on the same ground, and each must concede something to the other.

The statute prescribes that the weirs shall "*cause no obstruction to navigation.*" As a fish-weir must of necessity cause some obstruction, at least to some kinds of craft, this must mean that they shall cause no unnecessary or unreasonable or dangerous obstruction. But who shall decide the proper limit of obstruction? Just here is the defect in the statute. The fishermen have not fixed the limit to suit the sailors, and the sailors would not fix it to suit the fishermen. In point of fact, it has not been settled by any one, and the statute provides no way of settling it. What is needed is, that some disinterested party, giving due regard to the rights and requirements of each interest, shall impartially apply the provisions of the statute, which are intended for the protection of both interests, to the facts of each particular case.

It would seem proper that all structures which are permitted to encumber and obstruct the free use of tide waters, whether in the nature of fish-weirs or wharves, should be submitted to the same general tests of public safety and convenience, making due allowance for their location and the manner of their construction and use. Fish-weirs appear to have been built without much, if any, regard for such general rules, and sometimes, it would seem, in disregard of express statute limitations.

When the general court, by special legislative act, authorizes a bridge or other structure to be built in or over tide-waters, it requires that the plans for its location and construction shall be approved before the work begins. It would seem equally proper that, when a fish-weir is licensed, the plans for its location and construction should be approved in like manner; and, when built in accordance with such approval, the fish-weir should have, during the term for which the license has been granted, the same legal status and protection as a duly authorized bridge or wharf. In

this way, too, the rights and interests of navigation ought to find their full and due protection.

PROTECTION OF HARBORS.

There are several statutes of local application, intended for the preservation of harbors and navigable waters, which forbid the removal of sand, gravel, stones and other material, and the doing of other acts, which tend to the weakening or destruction of the beaches, headlands, bars and islands which form their shores or protecting barriers. There are other localities where such prevention is needed, and where no authority exists for its exercise. It is recommended that a general power be given to forbid and stop such acts wherever they are deemed prejudicial to the harbors and navigable waters of the Commonwealth.

It is provided in chapter 69, section 23, of the Public Statutes, that “ No person shall throw into, or deposit in a harbor, stones, gravel, ballast, cinders, ashes, dirt, mud, or any other substances, which may in any way tend to injure the navigation of such harbor.” No penalty is specially provided for the violation of this statute, and there seems to be none unless it be by the cumbrous process of indictment as for a nuisance. A small fine, bringing offences within the jurisdiction of the inferior courts, would in most cases be sufficient to prevent wrongful acts of this character, and would be a much more effective remedy; and it is recommended that such a penalty be enacted.

FIELD AND OFFICE WORK.

Miscellaneous Surveys.

The field work done during the year, beside the regular and constant work in connection with the various contracts for filling the South Boston Flats, in measuring the grade and amount of filling and determining the depth and extent of dredging, is as follows:—

In February, a survey of Duncan's Point and the north side of Harbor Cove in Gloucester Harbor was made, preliminary to recommending a change in the Harbor-line.

In the same month, the town line between Truro and Provincetown, across what used to be the mouth of East Harbor, was run out and defined in pursuance of chapter 196 of the Acts of 1881, by request and agreement of said towns.

In April, a survey was made of the shoal at the mouth of Neponset River, opposite Commercial Point, to ascertain in what condition it had been left by the contractors upon the completion of the work in connection with the "Improved Sewerage System" of the City of Boston. .

In the same month, a survey was made of Miller's River, to ascertain if it had been excavated in accordance with the terms of the license given to the Fitchburg Railroad Company.

In April and November, surveys were made in Fort Point channel of areas dredged by the Boston Wharf Company.

In November, a careful survey was made of the shoal off Piers Nos. 6 and 7 of the Grand Junction Wharves at East Boston, upon the petition of the Boston and Albany Railroad Company for its removal.

Re-survey of Boston Inner Harbor.

The re-survey of Boston Inner Harbor was continued during the summer around Jeffries Point, East Boston, as far as the Boston, Revere Beach and Lynn Railroad, and triangulation points were established along the north shore of South Boston, in order to continue the survey along that shore, as opportunity offers, during the coming season.

All of the above surveys have been carefully mapped in the office, and make a valuable addition to the archives of the Board.

Licenses granted and Plans approved for the erection of structures in and over tide-waters.

More than the usual number of applications have been made to the Board for licenses for wharves and other structures in and over tide-waters, and for the approval of plans for bridges and other tide-water structures authorized by acts of the legislature. A list of the licenses granted, and plans approved, seventy-nine in number, is hereto appended.

Nos.

712. Petition of the Philadelphia and Reading Coal and Iron Company for license to extend its Coal Pocket Wharf in the Harbor of New Bedford. Granted February 1, 1883.
713. Petition of Joseph H. Williams for license to construct a pile wharf on Swift's River in the town of Wareham. Granted February 15, 1883.
714. Petition of Edward P. Shaw for license to construct a pile wharf on the northwesterly end of Plum Island at the mouth of the Merrimack River in the City of Newburyport. Granted February 15, 1883.
715. Petition of Frederick P. Cheney and Patrick Driscoll for license to construct buildings over Little River in the City of Haverhill. Granted March 1, 1883.
716. Petition of the Commercial Wharf Company of Wellfleet for license to extend its wharf in the Harbor of Wellfleet. Granted March 15, 1883.
717. Petition of Charles F. Morse for license to extend his wharf on the Merrimack River in the City of Haverhill. Granted March 15, 1883.
718. Petition of John B. Nichols for license to extend his wharf on the Merrimack River in the City of Haverhill. Granted March 15, 1883.
719. Petition of Daniel Fitts for license to extend his wharf on the Merrimack River in the City of Haverhill. Granted March 15, 1883.
- 720 & 721. Petitions of Naylor and Company for license to fill flats in South Bay in the City of Boston. Granted March 22, 1883.
722. Petition of William H. Swift and Company for license to extend their wharf on Chelsea Creek in East Boston. Granted March 29, 1883.

Nos.

723. Petition of Montgomery and Howard for license to construct a launching-way on piles on Chelsea Creek in the City of Chelsea. Granted March 30, 1883.
724. Petition of the Roxbury Gas Light Company for license to construct a sea-wall and fill flats on Roxbury Canal in the City of Boston. Granted March 30, 1883.
725. Petition of George Lawley and Son for license to construct a pile wharf at the foot of O Street in South Boston. Granted April 12, 1883.
726. Petition of Jabez Davis for license to construct a pile wharf in Wood's Holl Harbor in the town of Falmouth. Granted April 19, 1883.
727. Petition of William B. Rice for license to construct a pile pier in Boston Harbor in the town of Winthrop. Granted April 19, 1883.
728. Petition of the Old Colony Railroad Company for license to extend its wharf in the Harbor of Provincetown. Granted April 19, 1883.
729. Petition of the Mercantile Wharf Company of Wellfleet for license to extend its wharf in the Harbor of Wellfleet. Granted April 19, 1883.
730. Petition of David Conwell for license to extend his wharf in the Harbor of Provincetown. Granted April 26, 1883.
- 731 & 732. Petitions of Cyrus A. Bartol for license to construct two wharves in the Harbor of Manchester. Granted April 26, 1883.
733. Petition of Theodore Brown for license to extend his wharf in the Harbor of Wellfleet. Granted April 26, 1883.
734. Petition of the City of Boston for approval of plans for the reconstruction of Warren Bridge across Charles River, as authorized by chapter 140 of the acts of 1883. Approved May 1, 1883.
735. Petition of Charles Parkhurst for license to extend his wharf partly solid and partly on piles in Gloucester Harbor. Granted May 3, 1883.
736. Petition of the Charles River Embankment Company for approval of plans for the construction of a sea wall and solid filling on the Charles River in the City of Cambridge, as authorized by chapter 211 of the acts of 1881. Approved May 3, 1883.
737. Petition of the Globe Coal Company for license to extend the "Fodman Wharf," so called, on Taunton Great

Nos.

River in the City of Fall River. Granted May 10, 1883.

738. Petition of the Columbian Rowing Association for license to construct a boathouse and raft in Boston Harbor. Granted May 10, 1883.
739. Petition of A. H. Fuller for license to construct a pile wharf and floating stage at Onset Bay in the town of Wareham. Granted May 10, 1883.
740. Petition of Albert C. Moody for license to construct a wharf in Boston Harbor in the town of Winthrop. Granted May 17, 1883.
741. Petition of the Commissioners on West Boston and Cragie Bridges for license to construct intermediate pile piers in West Boston Bridge over Charles River. Granted May 17, 1883.
742. Petition of James P. Chase and others for license to extend their wharf on the Merrimack River, in the City of Haverhill. Granted May 24, 1883.
743. Petition of John B. Farrar for license to extend his wharf on the Merrimack River in the City of Haverhill. Granted May 24, 1883.
744. Petition of Ezra Kelley for license to extend his wharf on the Merrimack River in the City of Haverhill. Granted May 24, 1883.
745. Petition of Levi Taylor for license to extend his wharf on the Merrimack River in the City of Haverhill. Granted May 24, 1883.
746. Petition of the Mercantile Wharf Corporation of Boston for license to construct a pile wharf in Boston Harbor. Granted May 31, 1883.
747. Petition of Dexter A. Hall and Patrick H. Carroll of Boston, for license to construct a pile wharf in Boston Harbor at South Boston. Granted June 7, 1883.
748. Petition of the Board of Health of the City of Salem for approval of plans for the filling of flats and the construction of a canal on North River in said city, as authorized by chapter 213 of the acts of 1881 and chapter 185 of the acts of 1883. Approved June 7, 1883.
749. Petition of Albert N. Nickerson for license to construct two wharves on Buzzard's Bay in the town of Marion. Granted June 15, 1883.
750. Petition of the A. T. Stearns Lumber Company for license

Nos.

to extend its wharves on the Neponset River at Neponset. Granted July 23, 1883.

- 751. Petition of the Franconia Iron and Steel Company for license to extend its wharf on Wareham River in the town of Wareham. Granted June 15, 1883.
- 752. Petition of the New Bedford, Vineyard and Nantucket Steamboat Company of New Bedford for license to construct a pile wharf at Gay Head in Vineyard Sound. Granted June 21, 1883.
- 753. Petition of the Bradley Fertilizer Company of Boston for license to extend its wharf on Weymouth Back River in the town of Weymouth. Granted June 21, 1883.
- 754 & 754^a. Petition of the United States for license to construct retaining and pier walls in Wood's Holl Great Harbor in the town of Falmouth. Granted June 22, 1883.
- 755. Petition of the town of Winthrop for approval of plans for the construction of a bridge across Crystal Cove in said town, as authorized by chapter 146 of the acts of 1883. Approved July 12, 1883.
- 756. Petition of Sylvanus Smith for license to construct a pile wharf in Gloucester Harbor. Granted July 26, 1883.
- 757. Petition of Augusta B. Thompson for license to construct a pile wharf in Gloucester Harbor. Granted July 26, 1883.
- 758. Petition of Benjamin Low for license to construct a pile wharf in Gloucester Harbor. Granted July 26, 1883.
- 759. Petition of John P. Gilman for license to extend his wharf on the Merrimack River in the City of Haverhill. Granted July 26, 1883.
- 760. Petition of the Eastern Junction, Broad Sound Pier and Point Shirley Railroad Company for license to widen and repair its wharf in Boston Harbor at Point Shirley. Granted July 20, 1883.
- 761. Petition of the City of Haverhill for approval of plans for the construction of a wharf and stone bridge at the mouth of Little River in said city, as authorized by chapter 82 of the acts of 1883. Approved July 20, 1883.
- 762. Petition of Nathaniel Webster for license to construct a solid wharf in Gloucester Harbor. Granted July 26, 1883.
- 763. Petition of James E. Margeson for license to construct a pile wharf in Gloucester Harbor. Granted July 26, 1883.

Nos.

764. Petition of the Trustees of Quincy and Hingham Bridge for license to construct a new draw in said bridge over Weymouth Fore River. Granted August, 2, 1883.
765. Petition of the Boston Gas Light Company for license to extend its wharf on Charles River in the City of Boston. Granted August 9, 1883.
766. Petition of John Gary and others for license to extend "Tufts Wharf," so called, on Charles River, Charlestown District, in the City of Boston. Granted August 15, 1883.
767. Petition of John E. Cassidy of Watertown for license to construct a wharf on Charles River, Brighton District, in the City of Boston. Granted September 6, 1883.
768. Petition of John Gary and others for license to construct a sea wall on Charles River, Charlestown District, in the City of Boston. Granted September 6, 1883.
769. Petition of the Trustees of the estate of John Carter Brown of Providence for license to extend French's Wharf on Fort Point Channel in the City of Boston. Granted September 6, 1883.
770. Petition of the Trustees under the will of John W. Trull for license to extend Lovejoy's wharves, so called, on Charles River in the City of Boston. Granted September 6, 1883.
771. Petition of the City of Boston for license to construct a wharf on the southerly side of Gallop's Island in Boston Harbor. Granted September 6, 1883.
772. Petition of the Boston and Lowell Railroad Corporation for license to construct a sea wall and solid filling on Miller's River in the City of Cambridge. Granted September 13, 1883.
773. Petition of Joshua Brown for license to construct a pile wharf in Salem Harbor in the City of Salem. Granted September 13, 1883.
774. Petition of Oscar Dubois for license to construct a stone wharf on Mount Hope Bay in the City of Fall River. Granted September 20, 1883.
775. Petition of the Town of Braintree for approval of plans for the construction of a new drawbridge and piers over Monatiquot River in said town, as authorized by chapter 31 of the acts of 1882. Approved September 20, 1883.

Nos.

- 776. Petition of the Haverhill Paper Company for license to construct a pile wharf on the Merrimack River in the town of Bradford. Granted October 18, 1883.
- 777. Petition of the City of Taunton for license to construct a bank-wall, coffer-dam and wharf on Taunton River in said city. Granted October 4, 1883.
- 778. Petition of Charles C. Hine for approval of plans for the construction of a causeway and bridge across Lagoon Pond at Vineyard Haven in the town of Tisbury, as authorized by chapter 38 of the acts of 1883. Approved October 18, 1883.
- 779. Petition of the Philadelphia and Reading Coal and Iron Company for license to extend its wharf on Acushnet River in the City of New Bedford. Granted November 1, 1883.
- 780. Petition of Emma J. Taylor for license to construct a wharf on Weymouth Fore River in the town of Quincy. Granted November 15, 1883.
- 781. Petition of Hamilton and Balcomb for license to build a pile structure on South River in Salem Harbor in the City of Salem. Granted November 8, 1883.
- 782. Petition of the City of Salem for license to construct a bulk-head and solid filling on South River in the harbor of said city. Granted November 8, 1883.
- 783. Petition of Joshua G. and Nathan G. Gooch for license to extend their wharf on Charles River, Brighton District, in the City of Boston. Granted November 15, 1883.
- 784. Petition of the Osterville Improvement Association for license to construct a wharf on Vineyard Sound at Osterville in the town of Barnstable. Granted November 22, 1883.
- 785. Petition of J. W. Stickney for license to construct two dolphins on Chelsea Creek in the City of Chelsea. Granted December 6, 1883.
- 786. Petition of Walter W. and Charles F. Wonson for license to extend their wharf on Rocky Neck in Gloucester Harbor. Granted December 6, 1883.
- 787. Petition of Robert A. Whyte for license to fill solid a portion of Sargent's Wharf in Boston Harbor. Granted December 6, 1883.
- 788. Petition of the Town of Braintree for approval of a change in plans for the construction of the draw-piers in the bridge over Monatiquot River in said town, as author-

Nos.

ized by chapter 31 of the acts of the year 1882.
Approved December 6, 1883.

789. Petition of the Philadelphia and Reading Coal and Iron Company for license to extend its wharf on Acushnet River in the City of New Bedford. Granted December 27, 1883.
790. Petition of the Boston Steamboat and Pier Company for license to extend its pier on Broad Sound in the town of Revere. Granted December 27, 1883.

MYSTIC RIVER.

The Mystic River Corporation was chartered by chapter 105 of the Acts of 1852. Additional acts have been passed from time to time in amendment and extension of its powers and privileges, and of the time allowed for completing its authorized work. By these several acts, authority is given to build sea walls, docks, warehouses and wharves, and to excavate and fill flats, in the Mystic River, within the limits and in the manner specified in the acts.

The places on the flats from which certain material was to be taken were to be approved by, and the whole work to be done under the supervision and to the satisfaction of, a special commissioner to be appointed by the governor, who was to report annually to the governor and council; and all the costs of his services and expenses were to be paid by the corporation, which was also authorized to sell its lands and improvements subject to his supervision. Other corporations have also been chartered having relation to the same scheme of improvement.

By chapter 234 of the Acts of 1883, the office of special commissioner was abolished, and all his authority, powers and duties were transferred to this Board, which now sustains the same relation to the work in the Mystic River as to all other like works in tide water.

The following communication of the president of the corporation contains information in regard to the operations of the last year : —

24 MILFORD STREET, BOSTON, January 7, 1884.

To the Board of Harbor and Land Commissioners :

GENTLEMEN, — In answer to a note received from your engineer, D. Koppman, on Saturday last, informing me that it was voted by your Board that “ Dr. Bartlett, President of the Mystic River Corporation, be requested to report to the Board all work and proceedings done by said corporation and its grantees ” during the past year, I herewith submit substantially what has been done, as follows : —

The Mystic River Corporation has continued the dredging of the flats on the northwesterly side of Chelsea Bridge and its enclosure adjacent thereto, and has filled up to grade with the material so dredged an area of about 40,000 square feet.

On the premises of its grantee, the Boston and Lowell Railroad Corporation, about 80,000 square feet have been filled to grade. About one half of this area has been surface filling above the eight feet grade previously filled with dredging ; the other half has been filled up to full grade with dredged material.

In addition to the above, about 20,000 cubic yards of material dredged from the flats bordering on the South Channel have been deposited on other portions of the premises of said grantee. All the dredged material above described has been taken from the flats and borders of the channels, in accordance with the requirements of the charter of the Mystic River Corporation.

Contracts have recently been made by said grantee as follows : —

1. For the completion of its quay line of sea wall, about 1,500 feet in length, extending from that portion previously built to the easterly line of Elm Street extended.
2. For a belt of pile wharf, 21 feet in width, extending along the said quay line above described.
3. For the dredging from the flats in said South Channel of an amount of material sufficient to fill to full grade an area of about five acres, already partially filled, in the rear of said sea wall.

All the above-named contracts provide for their completion by July of the present year.

Two dredging machines are now employed day and night in the prosecution of the above-named work.

Most respectfully submitted,

JOSEPH E. BARTLETT,
President of the Mystic River Corporation.

HARBOR IMPROVEMENTS BY THE UNITED STATES.

The Board is again indebted to the courtesy of the officers of the United States Corps of Engineers for interesting reports of the valuable works done under their supervision, in the harbors and on the coast of the Commonwealth, during the past season.

The charge of the work on the Southern section of the coast of Massachusetts, has been assigned by the United States Engineer Department to Lieut. Col. George H. Elliot, as successor to the late Gen. G. K. Warren; and the charge of the work on the Eastern section of the coast, formerly under Gen. George Thom, has been assigned to Maj. Charles W. Raymond. To each of these officers of the United States, the Commonwealth and the public are indebted for zealous and efficient service.

Improvements on the Eastern Coast of Massachusetts.

For information relating to the work done on the Eastern water-face of the Commonwealth, including the harbor of Boston, the Board has received from Maj. Raymond a clear and concise special report brought up to a recent date, which is presented in full below.

As an evidence of the careful and comprehensive study which Maj. Raymond has already made of the needs of Boston Harbor, attention is specially called to the mention in this report of a work of much importance to its navigation, inaugurated and executed by him, namely, the excavation of a channel between Long Island Head and Nix's Mate (through the Nubble), by which vessels of moderate draught can now pass by a direct and convenient course from George's into President Roads. This channel gives a shorter route for such vessels bound up the harbor than by the "Western Way," and avoids the difficulties and dangers of passing through the main ship channel at the Narrows while crowded by larger vessels.

Other important works of preservation and improvement in this and other harbors, to which attention is invited, are detailed in the report.

UNITED STATES ENGINEER OFFICE,
BOSTON, MASS., December 24, 1883.

The Board of Harbor and Land Commissioners, Boston, Mass.

GENTLEMEN:—In compliance with your request of November 22, 1883, I take pleasure in sending you the following abstract of work done, under my charge, by the United States in the harbors and rivers of the State of Massachusetts, during the past year.

1. Newburyport Harbor.

The north jetty, projecting from Salisbury Beach, has been completed for a length of 1,540 feet, and a submerged core, reaching to the plane of mean low water, has been carried 500 feet in advance of the finished work.

The south jetty projects from Plum Island. The shore extension, which consists of a sheet piling covered with stone, 507 feet in length, has been completed. Beyond the high-water line, the rubble-stone jetty has been finished for a length of 570 feet. The total length (completed) of the south jetty is 1,077 feet.

A dike 817 feet in length has been built across the mouth of Plum Island Basin.

A detailed hydrographic survey of the bar and entrance to the Merrimack River, and frequent surveys of the shore line, have been made for the purpose of watching the changes now in progress.

2. Merrimack River.

North Rock has been removed to a depth of 9 feet below mean low water, or 16.7 feet below mean high water. This depth of water now extends to a line 22 feet from the North Pier.

A survey has been made of the river channel at Rock's Bridge.

3. Sandy Bay, Rockport.

A detailed survey of Sandy Bay has been made; and a project for a breakwater to form a harbor of refuge has been prepared and submitted to the Engineer Department.

4. Lynn Harbor.

For the information of the Board of Engineers in connection with the study of the project for the improvement of this harbor submitted by Colonel George Thom, Corps of Engineers, a detailed hydrographic survey, observations of the tidal currents and a general study of the physical peculiarities of this locality have been made.

5. *Boston Harbor.*

Repairs have been made upon the sea walls at Deer and Lovell's Islands.

Aprons of rubble stone, with short projecting jetties, have been constructed on the northern shore of the eastern point of Gallop's Island and on the eastern and northern shores of Lovell's Island. These aprons have a total length of 2,708 feet, an average width of 30 feet, and an average rise of crest of 18 feet above mean low water. They contain about 14,000 tons of granite grout and chips.

The object of these constructions is the protection of the shores from the abrading action of the sea, which is not only causing the deposit of material in the main ship channel, but also changing the forms of the islands, thereby tending to diminish the resultant tidal scour.

The channel between Long Island Head and Nix's Mate (through the Nubble) has been dredged, for a width of 200 feet, to a depth of 12 feet at mean low water. A direct and convenient course has thus been made for vessels of moderate draught, and the main ship channel at the Narrows (before dangerously crowded) has thus been relieved.

In conformity with the general plan for the improvement of the main ship channel in the Upper Harbor, a spur of the Castle Island Shoal has been removed by dredging, and the width of the channel has thus been increased to 870 feet, with a depth of 23 feet at mean low water.

During the progress of this work, a rock of about 30 tons weight was discovered near the edge of the channel and about $16\frac{1}{2}$ feet below mean low water. Fragments of copper found in the vicinity and evidently torn from the bottoms of vessels, show that it has been a serious danger to navigation. It has been reduced in size and pushed to the edge of the shoal, and it will be removed as soon as possible.

6. *Charles River.*

A channel from 80 to 100 feet wide and 16 feet deep at mean high water has been dredged from a point 1,700 feet below Brighton Street Bridge, to a point 8,800 feet above it; in all a distance of about two miles. This channel will probably be completed next spring as far as the wharf of the Brighton Abattoir.

7. *Channel leading to Nantasket Beach.*

Fifty cubic yards of ledge were removed, giving the channel a minimum width of 100 feet and a depth of $9\frac{1}{2}$ feet at mean low water.

8. *Malden River.*

A channel $1\frac{1}{4}$ miles long, from 50 to 70 feet wide and 12 feet deep at mean high water, has been dredged below the drawbridge.

9. *Scituate Harbor.*

The north breakwater has been connected with the shore, and extended for a total length of 720 feet, with a height of about 5 feet above mean high water.

A brush and stone bulkhead 450 feet long, and a stone apron 385 feet long and 10 feet wide, have been constructed for the protection of the beach between Cedar Point and the main land.

10. *Plymouth Harbor.*

Along the western shore of the beach the bulkhead was prolonged for a distance of 830 feet, and the old portion was backed with cedar trees and small stone so as to render it sand-tight for a distance of 640 feet. A catch-sand fence of cedar trees and stone, 730 feet long, was also constructed parallel to and 15 feet east of the old crib-work, and a leak was stopped by backing 60 feet of the stone bulkhead with trees and small stone.

11. *Provincetown Harbor.*

The Long Point bulkhead has been extended 367 feet. Between the bulkhead and the crest of the beach, 5 groins, aggregating 490 feet in length, have been built of small trees and stone.

Very respectfully, your obedient servant,

CHAS. W. RAYMOND, *Major of Engineers.*

Improvements on the Southern Coast of Massachusetts.

By the courtesy of Lieut. Col. George H. Elliot, the Board has received a printed copy of his report to the United States Engineer Department of work done under his charge up to July 31, 1883, from which the following extracts are taken :—

Nantucket Harbor.

“ At the date of the last annual report, the work of extending the jetty on the west side of the channel of entrance was in progress under a contract, . . . and its extension was continued until January, 1883, when it was completed. The total amount of stone delivered under the contract was 16,123 tons. . . .

“ On the 24th of November, 1882, by direction of the Secretary of War, the work was transferred to Lieut. Col. George H. Elliot, Corps of Engineers. Work was resumed on May 4, 1883, and continued till the close of the fiscal year, when it was still in progress. . . .

“ Up to the end of the fiscal year, there had been delivered under the contract 9,223.78 tons of stone, leaving 3,776.22 tons to be completed, which was expected to be delivered during the month of July. The length of the completed stone work at the same time was 2,894 feet, and, including the stone and timber work at the inner end, the total length was 3,075 feet.

“ There has been some settling of the jetty for about 500 feet at its length near the shore end, where it was built in shoal water on fine sand. To rebuild this part of the work to its proper width and height, will require about 600 tons of stone.

“ There have been some minor changes in section in some of the parts of the jetty by the action of the waves, or scour of the bottom, or both, which will require an additional amount of stone, and, to prevent the lateral dispersion of the ebb-tide to the westward through the jetty, it is proposed to fill with chip stones the interstices of parts of it which were somewhat loosely built. The amount of stone required for both of these objects is estimated at 800 tons, making the whole amount of stone yet required to be placed in the existing part of the work 1,400 tons.

“ During the last fiscal year frequent surveys have been made to discover what changes, if any, were taking place in the channel and on the shores near the work.

“ A large deposit of sand west of the jetty, in the angle between the jetty and the shore, still continues. To the eastward of the jetty there has been but little deposit of sand along the shore, and but little change in the channel. Careful soundings, from time to time, show only minor changes in the depths, but these are generally not constant. One survey may show a deepening, and the next one a shoaling, in the same locality; but the general result seems to be a slight deepening of the channel, although, by reason of the irregularity of the changes, the navigable depth has not been increased. It was not anticipated that any marked change would occur before the jetty reached the outer bar, from which (or rather from the outer 12-foot curve) it is now distant 2,785 feet, and it was thought that it might be found, even then, that a second jetty, starting from Coatue Point, on the east side of the entrance, would be required.

“ The spurs, or short jetties, built out from Coatue Point to arrest

the abrasion of the shore, have been somewhat extended during the year, and there seems to be no danger of further damage here.

"It is proposed with the remainder of the funds available for this harbor, to continue the extension of the west jetty towards the outer bar, since, in any event, this jetty must be finished to the point where the other is found necessary or not, in order to direct the current across it, to protect the channel from waves, from ice, and from the sand which moves with the littoral current from the westward. In continuing the work, it is proposed to make it as compact as practicable, in order to prevent the dispersion of the tide through it. It is also proposed to continue the observations to determine the velocity and amount of tidal flow, to furnish a basis on which to fix the width of channel and the location and length of the east jetty, should one be required."

Wood's Holl Harbor.

"At the date of the last annual report, no work was in progress.

"By the act of Congress of August 2, 1882, \$52,000 was appropriated for a harbor of refuge at Wood's Holl, an estimate for which had been submitted by the late Gen. Warren. This estimate contemplated the construction of a breakwater pier, a basin for the use of the United States Fish Commission, and wharves for the use of that Commission and other branches of the public service. . . .

"The project was approved by the Secretary of War on the 2d of February, 1883, and the fee-simple title to the land was acquired by the United States Fish Commission, April 20, 1883. . . .

"The retaining walls are to be built along the front of the old marine railway in the Great Harbor at Wood's Holl, in about 6 feet of water at mean low water, and of an aggregate length of about 520 feet. The pier walls, of an aggregate length of about 570 feet, and founded in water from $10\frac{1}{2}$ to 20 feet depth at mean low water, are to form a hollow pier in front of the retaining walls. . . .

"It is probable that the present appropriation will not be sufficient for anything more than the work already advertised for, and that the wharfing, the filling in behind the retaining walls, and the dredging inside the pier and in front of the wharves, will have to be provided for by future appropriations. The estimated cost of them is \$25,000."

Considerable work has been done in prosecution of the above scheme since the report of Lieut. Col. Elliot was made, the details of which cannot now be given.

Wareham Harbor.

“By act of Congress of August 2, 1882, \$5,000 was appropriated for continuing the improvement [of this harbor] which contemplated the further construction of works at Beach, designed to protect it from the sea. . . .

“A wall of brush and stone, 150 feet in length, similar to the one formerly built at this place, was constructed across the west end of the beach near the line of mean high water, and another of the same kind, 950 feet long, commencing near the west end of the stone and brush wall built in 1878, was built parallel to and 15 feet from it. A vertical sand-catch fence, 10 feet high and 1,032 feet long, of scantling and boards, similar to those which have been successfully built on the shores of the western lakes, was built between these parallel stone and brush walls. Another sand-catch fence, 7 feet high, similar, but inclined towards the sea, was built from the end of the vertical fence just mentioned 832 feet to the eastward. . . .

“The construction of sand-catch walls of stone and brush was commenced [June 21, 1883] at the north side, which had worn so much as to endanger the works previously built. Two hundred and seventy-two feet of these walls were completed up to the end of the fiscal year. In addition to this, an area of 30 feet square on the sea side, where it is washed by the waves, was covered with brush weighted down with stone, as an experiment. It is thought that the sand brought in by the waves will be caught and that in this way the beach may be raised.

“With the remainder of the appropriation, it is designed to continue the stone and brush wall, just built on the north side of the point, about 310 feet further to the eastward; to build six spurs, each about 20 feet long, running westward from the stone and brush wall which has been built across the west end of the point; to build out from the south side of the point four additional stone and brush jetties of a total length of about 500 feet; and to fill inside the triangular frames on which the wooden sand-catch fence has been built, with brush, with the view of catching the wet sand which is now washed through this fence by the waves from seaward.

“The amount of the last appropriation was not considered sufficient to warrant any attempt to continue the work of deepening the harbor, which constituted the main portion of the original project, and is yet incomplete.

“The estimated cost of the work in Wareham Harbor was \$44,050. Of this amount there has been appropriated \$15,000.”

Taunton River.

At the date of the last annual report, work was being prosecuted under a contract, . . . in dredging to secure, between Weir and the Needles, a depth of 11 feet at mean high water, with a width of 60 feet, and additional width at the bends.

Up to January 1, 1883, there had been removed 40,313 cubic feet of material, and the enlarged channel was carried from Phillips's Wharf to Peter's Turn, a distance of $1\frac{1}{2}$ miles. Work was resumed under the same contract on the 12th of April, 1883, and continued until the 31st of May, 1883, when it was completed, except a small amount of work at the fishery near North Dighton, which was left until the fishing season was over.

By act of Congress of August 2, 1882, \$25,000 was appropriated for continuing the improvement of Taunton River. . . .

In the first section (The Needles, Briggs' Shoal, The Nook, and a part of the river at Wikamount) the material was stated to be mud, gravel, clay, pebbles, and bowlders under two tons. In the second section (Berkley Bridge Shoal, a part of the river at Wikamount, and between Peter's and Ferry Points) the material was stated to be mud, sand, and gravel.

"The channel was to be made 11 feet deep at mean high water above Berkley Bridge Shoal, and 12 feet on and below that shoal, the existing depths being from 5 feet to the proposed depths. . . .

"Mr. Beard commenced work under his contract at The Needles, and, up to the end of the fiscal year, he removed 5,672.82 cubic yards from that shoal and from Briggs' Shoal. The work is still in progress. . . .

"There is now a continuous channel 11 feet deep at mean high water from the bridge at Weir to Briggs' Shoal, a distance of 3 miles; but there are many scattering bowlders in the channel . . . which will be removed later in the season. . . .

"The remainder of the work near North Dighton will be completed early in this fiscal year. . . .

"The estimated cost of the approved project for the improvement of this river was \$94,000, of which \$67,500 has been appropriated, leaving \$26,500 to complete. . . .

"The completed improvement will enable three and four masted schooners, carrying from 600 to 1,400 tons, and barges of equal capacity, to reach Taunton."

IMPROVEMENTS IN THE CHANNELS OF BOSTON HARBOR.

For the purpose of illustrating the improvements which have to date far been made, both by this State and by the United States, in the channels and deep-water facilities of Boston Harbor, and also, to some extent, pending and projected improvements, a Plan has been prepared, and is appended to this Report, on which are indicated the outlines and extent of the several areas which have a depth of water of 23 feet and over at mean low tide.

The plan shows both the natural and the improved deep-water areas above the passage-way between Governor's and Castle Islands, with distinguishing signs for the parts deepened by the Commonwealth and by the United States respectively. The water-space of President Roads, and other areas of a depth of 23 feet and over, which lie below this passage-way and above that between Long Island Head and Deer Island Spit, are also shown.

The term "inner harbor" is generally applied to the upper and smaller basin, which lies above Governor's and Castle Islands and below the bridges, and which contains, within the limits of projected improvements, an area of about 1,150 acres. But what is really the *inner harbor*, or may properly be so regarded, is the larger area comprising the water-spaces (including this upper basin) which are enclosed and protected by the high grounds of East Boston and Winthrop on the north, Deer Island and Long Island on the east, and Spectacle Island, Moon Head and Squantum on the south, — a nearly land-locked basin, — capable of an improved area of not less than 6,300 acres. This includes President Roads, which in itself contains nearly *one thousand acres of anchorage ground of the first order* as regards depth of water (twenty-three to fifty feet at mean low tide), holding ground and shelter.

The width of entrance (between Long Island Head and Deer Island Spit) to this larger "inner basin," while amply sufficient, is less in proportion to the water-space enclosed (thereby affording better shelter) than the entrance to the smaller basin above described; and the latter has required artificial deepening to 23 feet, while the outer gate-

way has a bold and deep threshold (over 50 feet deep) leading at once into a basin which has, as before stated, a storage capacity of a thousand acres.

The plan further shows the approaches from below to this latter entrance, by the deep-water channels from Broad Sound and through the Narrows, with the improvements in the latter channel, and the cut through the "Nubble" between Long Island Head and Nix's Mate, which have been made by the United States.

Characteristic soundings are also given, showing the general natural and artificial depths in the several parts of the harbor which are covered by the plan.

As elsewhere stated, the plan may also be interesting and useful as exhibiting the relation of the reclamation of the South Boston Flats to the improvement of the harbor, and the large increase of deep-water frontage which will thereby be secured. The portion of these flats already sold, the sections in process of filling under the several contracts elsewhere mentioned, and the large area still open to improvement, are severally indicated on the plan.

ARCHIVES OF MAINE LANDS.

By chapter 99 of the acts of 1883, the custody of the books of records of grants and conveyances of lands formerly held by the State of Massachusetts, and now within the limits of the State of Maine, and of all other books and records relating to said lands, was transferred from this Board to the Secretary of the Commonwealth. All such archives were accordingly transferred to the office of the Secretary on the 8th day August, 1883, and his receipt taken therefor.

JOHN E. SANFORD.
HENRY L. WHITING.
JOHN I. BAKER.

BOSTON, January 1, 1884.

APPENDIX.

APPENDIX.

[A.]

SUPPLEMENTARY AGREEMENT, MADE THIS FIRST DAY OF OCTOBER, 1883, BY AND BETWEEN THOMAS POTTER, PARTY OF THE FIRST PART, AND THE COMMONWEALTH OF MASSACHUSETTS, PARTY OF THE SECOND PART.

WHEREAS, the said parties, on the 28th day of August, 1880, entered into an agreement in writing, and on the 26th day of December, 1882, entered into a further or supplementary agreement in writing, both of which are referred to and made a part hereof as if fully recited herein, whereby the said Potter, upon the terms and conditions in said agreements set forth, agreed to do certain dredging in Boston Harbor, and with the materials so dredged to fill certain flats of said Commonwealth at South Boston ;

AND WHEREAS, it was stipulated in said agreement that the aforesaid dredging and filling should be completed by said Potter on or before the first day of January, 1884 ;

AND WHEREAS, the said Potter will be unable to complete said work on or before said first day of January, 1884, and desires an extension of time for completing the same ;

AND WHEREAS, it was also stipulated in said agreements that the aforesaid dredging should be done from a certain space or area colored red on the plan annexed to the aforesaid agreement of August 28th, 1880 ;

AND WHEREAS, it may be found expedient not to excavate at present a portion of the said area, but to substitute therefor a certain other area hereinafter described ;

NOW, THEREFORE, IT IS AGREED by the parties hereto, that the time for executing and completing the work stipulated to be done by the said Potter in the agreements aforesaid, shall be, and is hereby, extended to the first day of June, 1884.

IT IS ALSO AGREED, that the area shaded red on the plan hereto

annexed, shall constitute a part of the space or area from which, in the discretion of the Board of Harbor and Land Commissioners, and by the direction of its engineer, the said Potter may be required to dredge material in the execution of the work to be done by him under the aforesaid agreements; and that the said Potter shall not have or claim, under said agreements or otherwise, any extra or additional compensation on account of such change or substitution of areas.

All the provisions of said agreements of August 28th, 1880, and December 26th, 1882, regarding rate of compensation per cubic yard, depth and manner of dredging, and otherwise, shall, notwithstanding said extension of time, and said change or substitution of areas, be and remain in full binding force upon the parties hereto, except so far as expressly modified by the provisions of this agreement as aforesaid.

In testimony whereof, the said Thomas Potter has hereunto set his hand and seal, and the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered, in its name and behalf, by its Board of Harbor and Land Commissioners, the day and year first above written, and the same to be approved by its Governor and Council.

THOMAS POTTER. [SEAL.]

COMMONWEALTH OF MASSACHUSETTS,

BY JOHN E. SANFORD,	}	<i>Harbor and Land Commissioners.</i>
HENRY L. WHITING,		
JOHN I. BAKER,		

In Council, November 20, 1883. Approved.

[SEAL OF THE
COMMONWEALTH.]

HENRY B. PEIRCE,
Secretary.

[B.]

ARTICLES OF AGREEMENT, MADE THIS FIFTH DAY OF DECEMBER, IN THE YEAR EIGHTEEN HUNDRED AND EIGHTY-THREE, BY AND BETWEEN THE COMMONWEALTH OF MASSACHUSETTS, ACTING BY ITS BOARD OF HARBOR AND LAND COMMISSIONERS, PARTY OF THE FIRST PART, AND THE NEW ENGLAND DREDGING COMPANY, A CORPORATION DULY ESTABLISHED UNDER THE LAWS OF MASSACHUSETTS, PARTY OF THE SECOND PART.

The said party of the second part hereby covenants and agrees with said party of the first part to dredge the entire area of that part of Fort Point Channel between Congress Street and Federal Street bridges, which is shaded red on the plan hereto annexed, to the depth of sixteen feet below mean low water, and to deposit the dredged material at the place provided for such material by said party of the second part under a contract between said parties, dated July 1st, 1882.

The party of the second part agrees not to injure the bridges or draw piers in any way, nor to endanger their foundations by excavating below the plane of sixteen feet below mean low water, and to use all diligence to complete the work as soon as practicable.

All the work aforesaid shall be done to the satisfaction and acceptance of said Board of Harbor and Land Commissioners, and subject to the direction of the engineer of said Board.

The party of the first part will furnish all facilities in its power for executing the work, by having the draws left open when practicable, and by preventing the passage of vessels through the draw-ways when said passage would interfere with said work.

The party of the first part hereby covenants and agrees with said party of the second part, upon the due completion of the work aforesaid, to pay said party of the second part the sum of seven thousand five hundred dollars (\$7,500), the same to be in full compensation for all work, expenses and delays done and incurred by said party of the second part in the execution of this contract.

In testimony whereof, the said Commonwealth has caused its seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf, by its Board of Harbor and Land

HARBOR AND LAND COMMISSIONERS. [Jan. '84,

Commissioners, and the said New England Dredging Company has caused its corporate seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf, by Charles H. Souther, its President and Treasurer, the day and year first above written.

THE COMMONWEALTH OF MASSACHUSETTS,

BY JOHN E. SANFORD, HENRY L. WHITING, JOHN I. BAKER.	}	<i>Harbor and Land Commissioners.</i>
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NEW ENGLAND DREDGING COMPANY,

[SEAL OF THE
N. E. DREDGING
COMPANY.]

BY CHARLES H. SOUTHER,
President and Treasurer.

Witness the Seal of the Commonwealth.

[SEAL OF THE
COMMONWEALTH.]

HENRY B. PEIRCE,
Secretary of the Commonwealth.

